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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

OFFICE AMERICAN GAS-LIGHT ASSOCIATION,
117 BROADWAY, N. Y. CITY.

To the Members of the Association :

In continuation of the notice printed in the last number of the AMERICAN GAS LIGHT JOURNAL, the following list of topics is given by way of suggestion to you as comprising topics on which it is desirable that papers should be prepared and read before the Association, such reading to be followed by the usual discussions :

Naphthaline in Coal Gas.

The Relative Advantage and Cost of Purifying Gas with Oxide and with Lime.

The best Means of Removing and Disposing of Foul Lime.

Gas Manufacture in America and in Europe Compared.

On Furnaces for Heating Retorts.

Comparative Advantage of Centre-Valves, Surface and Hydraulic, and other Systems of Valves for Purifiers.

The best Method of Setting Retorts.

On the Price of Coal, and Rate of Wages, as Affecting the Cost of Gas.

Gas for Heating and Cooking Purposes ; the most Economical Methods of Applying.

Deposit of Carbon upon Retorts ; Its Prevention and Removal.

Results of Experiments In Using Different Burners for Lighting Purposes.

On Stoppages in Ascension and other Pipes ; Their Cause, Prevention, and Remedy.

Is the Removal of the Dip Desirable ?

Trussed and non-Trussed Gasholders ; Their Relative Cost and Advantages.

Laying and Connecting Services, and Means for Preventing Rapid Oxidation.

The Cheapest and best Form of Condenser.

The Proper Amount of Labor for the Production of 100,000 Feet of Gas, when the Annual Make is 100 Millions.

The Best Means of Extending the Use of Gas, and How Its Consumption May Be Increased.

Information to Consumers. What does the Consumer Require, and What Is the best Means of Supplying It ?

Proportionate Capacity of Apparatus, and Standards for Capital and Expenditure, per Thousand Feet of Gas Sold.

The Use of Gas as a Motive Power : Results of Actual Experiments, Giving Cost of Power.

Members of the Association are not to understand that the above list prevents them from preparing a paper on any other subject which may suggest itself to them ; but they are especially requested to select any of the above topics, or any other subject which may be agreeable to them to present to the Association, the main purpose being to procure and have the papers and the discussion upon them.

CHARLES NETTLETON, *Secretary.*

By the above notice it will be seen that active measures are being taken to secure for the October Meeting a series of papers that will prove, not only interesting, but practical and instructive to every member.

It is to be hoped that every member will at once begin to jot down facts and points that may be of value in the discussions, even if the papers are short. Every member is well aware that the points developed in the discussions are often more valuable than those advanced in the papers. This is, of necessity, so ; and should not, by any means, deter any one from preparing papers, for it is often the case that the real value of a paper is the discussion it provokes rather than in what says.

During the past year we are confident that many economies have been forced upon managers by the stringencies of the times ; and, although the business outlook is decidedly better, still this improvement must be accompanied with a reduction in the price of gas. Gas can be made to-day cheaper than ever before ; and, at the same time, other means of illumination are equally reduced in price. By reference to our last issue it will be seen that oil was never so cheap, and never so abundant, as now—and oil is the real competitor against which gas has to contend. The electric light may have its special field of usefulness, but the greatest economy attainable in the use of it to-day is when used in a single, large, intense light, at a single center. But the oil lamps can be used anywhere, and all that is necessary to compete successfully with the oil lamp is to put the price of gas where it can be shown

to be cheaper than oil, when the trouble, annoyance, and danger of using the latter is considered. This involves the use of proper burners, the guaranteeing a suitable pressure, and the maintaining a proper illuminating power.

Behind all this is another point which is often the most serious obstacle that the engineer has to contend with, and that is the "Capital."

As we have often shown before it is hard to compete with oil where the amount of capital is such that it takes as much as the whole cost of gas distributed to pay a reasonable dividend. This is a vital point, and one that needs to be carefully considered by every company. If business is to be secured, and increased, the capital must bear some reasonable proportion to the value of the plant necessary to carry on the business economically.

All these are points that need to be carefully worked out and agreed upon, so that there may be some uniformity in the matter, and that men engaged in the same business may be able to have a common standard of comparison by which each may see how he is doing as compared with others.

The Electric Light.

The London *Journal of Gas-Lighting*, of April 29th, speaks of the electric light as follows:

"The electric light continues to be what we may profanely call a bugbear. It has, of course, its uses and recommendations; but when gas shareholders look upon it with alarm, they betray much simplicity of mind. All authorities on the matter concur in expressing an opinion that gas can hold its own against all competitors. We are alive to the fact that great improvements may be made in the distribution of electricity, by which means advantages may be gained, which are not now attainable, in the lighting of closed and divided spaces. Such discoveries, however, at the present moment, look distant. The gentleman who was to revolutionize the art of illumination has now issued his English patent, and that most bitter enemy of gas companies, *The Time*, admits, after a fair description of Mr. Edison's specification, that, 'In the presence of a specification which can thus be summed up, it seems tolerably certain that the proprietors of gas shares may possess their souls in peace, and that the general introduction of electric lighting must be deferred until some more solid progress has been accomplished.'"

The policy of gas companies at this juncture—we cannot call it crisis—is clearly pointed out. It is to push the employment of gas for other than illuminating purposes. Although, as we have repeatedly said, gas has nothing to fear, in its chief citadels, from the competion of the electric light, even in the homes of the masses it is susceptible of a much more extensive use, and nothing but encouragement is wanting to make it the common domestic fuel."

[The wonderful reports, recently published, as to the wonderful success of the light in Cleveland, Ohio, are evidently drawn from the lively imagination of those connected with the daily press rather than from absolute fact.—Ed.]

Department of Public Works.

Extracts from Report for the Quarter Ending December 31, 1878.

Department of Public Works,
Commissioner's Office, Room No. 19, City Hall,
New York, February 25, 1879.

Hon. Edward Cooper, *Mayor of the City of New York:*

Sir—In accordance with Section 27 of the Charter, I have the honor to submit herewith a report of the transactions of this Department for quarter ending December 31, 1878:

[Continued from page 200.]

Electric Light.

In my report for the quarter ending Dec. 31, 1876, I intimated that probably the time was not far distant when our streets and public places might be lighted by other methods than those then in use. I then had reference to the electric light, which has attracted considerable of the public attention during the past few years.

The light, although called the new light, is not entirely new, inasmuch as it was first produced by Sir Humphrey Davy in the early part of the present century. In 1831 the light was produced by Faraday, on the discovery by him of the induction currents by the aid of magnets, which led to the construction of a magneto-electric machine, and dispensing with the use of a battery. In 1846 the light was applied in the Opera House at Paris to produce the effect of the rising of the sun, and it has been known and used in laboratory experiments for many years. It is only within the last ten years, however, that any practical results heve been reached toward making it in any way effective for lighting purposes.

The light is obtained by two methods, one by incandescence, or the production of light by heating platinum or retort carbon to whiteness by the electric current. This is the system now being experimented upon by Edison and other scientists for the production of a light of small focus, suitable for purposes of ordinary illumination; and notwithstanding numerous efforts have been made to effect this object, no definite result has yet been reached, or at least nothing has as yet been exhibited in this country, although it has been asserted that Edison had solved the problem, and that the lamp just patented by Messrs. Sawyer and Man, of this city, is said to meet the emergency.

The other method is by the "Voltaic Arc," so called in honor of its discoverer, Volta, an eminent Italian physicist of the last century. It is this system which is now being used in Paris and other European cities to some extent, and which has been on exhibition in our own city and vicinity during the past year. The arc is produced by placing two carbon pencils, or, more properly called, electrodes, in vertical positions, one above the other, with their points in contact. On the application of the electric current, and the separation of the points to a proper distance—about one-tenth of an inch—the electric fluid passes from the positive to the negative carbon, and an intensely brilliant luminous arc appears, which remains so long as the distance between the carbon points is not too great, and so long as the electric current is maintained. This is what is termed the electric light.

The apparatus or appliances required for the successful production of the light consist of an engine for supplying the necessary motive power to the machine (and it is of the highest importance that the engine employed shall be capable of performing its functions with the utmost regularity of movement; there must be no sudden jerking or irregular motions, but, on the contrary, its work must be performed in an easy, steady, and regular manner during all its continuous revolutions; the power required is about 2-horse power per lamp); a magneto-electric machine, for generating a continuous and powerful current of electricity; a lamp containing the carbon electrodes; two carbons for each lamp, from which the light is obtained (one is called the positive and the other the negative carbon); a regulator or contrivance for establishing and constantly maintaining a proper distance between the carbons; the necessary copper wire for conducting the electric current from the generating machine to the lamp.

It has, no doubt, been presumed by some that the electric force is produced in the manner ordinarily employed by electricians, but it is not so, for no battery is used, nor zinc, acids, or other chemical agents employed, although it can be so obtained for laboratory experiments, or for lighting on a small scale. The electric current required for effective electric illumination is magneto-electricity, and is obtained from the machine, as before stated, by the aid of steam or other motive power.

Generating machines of various kinds have been devised in Europe, and several in this country, the American machines being equal, and in some respects superior, to those made abroad. They generally bear the name of their inventor, and, although of different form and make, are all based upon the same principle. The latest and, said to be, the best machines in Europe are the Gramme and the Siemens, manufactured in Paris, which are used in lighting several manufacturing establishments and yards, and are also employed on several vessels of the French and Russian navies. In this country we have the Hochhausen, the Weston, the Fuller, the Walace-Farmer, and the Brush machines.

Among other serious objections or drawbacks to the use of the electric light is its almost constant wavering or fluctuations, or we might call it a severe blinking, frequently presenting the appearance of about being extinguished, and showing no luminosity, but only a live coal or red ember. This, has, no doubt, been noticed by all observers. This defect arises from several causes, one of which is from the irregular action of the motor or machine, which is transmitting a varying current of electricity; others arise from the carbons, sometime by impurities, but most generally by the gradual separation as combustion goes on. The positive carbon is wasted away twice as fast as the negative carbon; hence the space between the two points becomes too great, the voltaic arc is lost, and the light disappears and is gone until the positive carbon is again brought in contact with the negative carbon and then separated to the proper distance, when the voltaic arc is again renewed, and the light reappears in all its brilliancy. To remedy the defects of the separation of the carbons, and to provide a steady and even light, regulators of various kinds have been devised, some composed of a sort of clock-work mechanism, some worked by counterpoise weights, and others by a magnet only; and, notwithstanding much has been done in the way of improvement, much more yet remains to be done before the difficulty is entirely overcome.

Considerable attention is now being paid to the manufacture of the carbon electrodes, as it is very requisite that they should be chemically pure in order to provide a regular and brilliant light. The carbon pencils first used were made from the retort carbon found in gas retorts, which was cut

to proper size and shape. It was found, however, that this material contained some objections ; it does not possess a uniform density ; it is quite brittle, and hence is liable to splinter and break ; it contains foreign matters, and these produce considerable variations in brilliancy. A very good carbon is now made from the best coke, which is pulverized to a fine powder and mixed with some suitable gummy substance into a paste, then pressed in moulds to the proper form and baked, and sometimes covered with a coating of copper. They are in shape generally cylindrical or rectangular, varying in size from a quarter inch to one inch, and are of various lengths ; the Wallace lamps sometimes use carbons in the shape of blocks one-half inch in thickness and from two to ten inches in width.

From the foregoing description all technical phrases have been omitted, so that an insight can be obtained as to what is required for the production of this so-called "wonderful light," which is promised to revolutionize the whole field of artificial illumination. During the past year the public has had frequent opportunity of seeing it in operation and witnessing its effects. It has been shown at Manhattan Beach, where three lamps were lighted by the Hochhausen machine, run by a ten-horse power Baxter engine. It was used outsdie of Gilmore's Garden, the Cathedral Fair, Macy's, and Lord and Taylor's by the same parties, and with good effect, the naked light being shown at these places. It is now employed at the Equitable building, where two "Maxim" lamps are used, in ground glass globes, for lighting the basement hall, and fed from a Wallace machine. It was exhibited at the late fair of the American Institute, at which place twenty-five lamps were lighted, all in opal or ground glass globes. Of these, twenty-one were supplied from five Wallace machines, and four from one Brush machine. Nineteen of the Wallace lamps were in the main building, and inclosed place 285 feet by 135 feet, and the four Brush lamps were in Machinery Hall. In addition to the above twenty-five electric lamps, all the gas burners were kept lighted, although the gas was slightly checked at the meter. This was a wise precaution, because, first, the electric lamps did not afford sufficient light, and, second, to guard against the risk of the building being placed in darkness in case of accident to the engines or machines.

With a view of ascertaining whether the use of this light can be made available in any of the public buildings or places over which this Department has jurisdiction, I have frequently examined all the lamps and machines shown in this vicinity, and have given the matter careful consideration. I have looked at it from various standpoints, and, having studied its merits and demerits, I know that it cannot be used with advantage by this city. I am also free to assert that the electric light, as at present constituted, cannot compete with gas as an economical, convenient, and reliable illuminating agent for the ordinary purposes of artificial light.

When considering the adoption of this light, and entirely dispensing with gas, the question of its reliability for general use should certainly be taken into account, and we should see whether it can be depended upon at all times and under all emergencies, without interruption or possible failure, for furnishing a perfectly sure and steady light. We know that electricity cannot, as can gas, be stored for future expected uses, but that it must be generated or produced as and when needed. We also know that artificial light is required, more or less, at all times of the twenty-four hours of the day. The necessities of some parts of a building may require artificial light during the day, while other parts may need light only at night ; some parts may require a few lights of small volume, another part many lights of large volume, and these requirements may frequently vary. During the winter months a vast amount of artificial light is required ; during the summer, comparatively little. With gas the supply can be regulated and the distribution insured, and a slight accident at the works need not affect the consumer. In summer but little coal need be carbonized, and but few retorts kept at work. It is not so, however, with the electric light ; as for this, the same magneto-electric machines must be used in the summer as in the winter, and the varrying necessities of a house cannot well be known.

To produce the light by the electric current these engines and machines must be kept constantly and incessantly at work, and the machines moving at the rate of of from 800 to 1,000 revolutions per minute, there can be no cessation, not even for an instant, for the moment the engine or machine stops its work, that moment the electric current ceases. Now, all persons having any knowledge of machinery, particularly of the steam engine, are well aware of its liability to sudden derangement ; how, at any inopportune moment, when least expected, and when it can least be spared, something may give out, such as the cracking of a crank-pie, the loosening of a screw, or perhaps some more serious matter, and when such things occur, out goes the light, and no more can be obtained until repairs have been made or other motive power of machinery supplied. It would seem, therefore, most essential that in order to provide for such emergencies, and to insure an almost continuous and permanent light, it would be necessary to have and extra engine or machinery ready for immediate use,

In the foregoing remarks I have referred only to the electric light of to-day, and with the view of showing that this city cannot use it with advantage. I do not mean to assert that the future will not bring forth better results, but I do say that until some practical method is devised for subdividing this light—that is to say, instead of giving one intense light of two or three thousand candles, giving an equivalent number of lights of small focus, varying from six to twenty candles, and doing this without the enormous loss of electric force, and in an economical and perfectly reliable manner—there is not much probability that this light will ever be applied to general household illumination.

Of course, there are many places in which it can now be utilized with advantage. In lighting mines, by incandescence and in vacuum, it would be an excellent substitute for the feeble and sometimes dangerous miner's lamp. For lighting large yards, factories, lighthouses, large excavations, river steamboats, ocean steamers, steamship piers, and other places where surplus motive power is at hand, it might be used with good effect. It might also be made available, if not very economical, in a large park, like Central Park, where it is not deemed expedient or desirable to lay gas mains. In cases such as these the electric light will have its sphere in the lighting world, as gas will hold its own place.

No doubt the demand for gas may be lessened in some places where the new light might be substituted, but what business might be lost in this way can more than be made up in another ; for by proper and earnest effort on the part of gas managers the use of gas can be extended to purposes other than those of illumination.

Let the gas makers of the world take advantage of every improvement in the method of its manufacture, so that its production will be cheapened, its quality improved, the residual products utilized, the expense of distribution economized, and the leakages reduced to a minimum ; then let the managers endeavor to educate the people as to the advantages to be obtained from its further use, and I venture to say that the consumption of gas, instead of being diminished, will be very largely increased during the next decade.

Very respectfully,
S. McCormick,
Superintendent of Lamps and Gas.

The following is the Exhibit "E" referred to in the report, being a table showing the number of lamps, size of burner, number of hours burning, price per thousand feet, etc., in the various cities of this country and Europe:

City or—	No. of Lamps.	Size of Burner.	No. of Hours Burning per Year	Price per Lamp per Year.	Distance between Lamps	Price to Private Consum'rs per 1,000 Feet.
		Feet.			Feet.	
Albany, N. Y.	1032	3	3833⅓	$35 00	300	$2 50
" Oil	1042	3	3833⅓	35 00	300	.....
Baltimore, Md.	5799	5	2400	32 00	....	$1 50 & 1 90
Brooklyn, N. Y.	13892	3	3536¾	30 16	130	2 50
Boston, Mass.	9992	4	3828	36 41	180	$2 25 2 50
" Oil	2077	4	3828	36 41	180	& 3 00
Buffalo, N. Y.	4518	4	3250	26 00	125	2 25
Cincinnati, O	5842	4	2500	21 10	133	2 25
" Naph.	732	4	2500	21 10	133	.....
Columbus, O.	895	5	2240	22 64	187	2 25
Chicago, Ill.	10691	4	Moon.	$2 per 1000	125	$2 25 & 2 50
Glasgow, Scotland	9000	2	3711	$9 75	150	1 00
Hartford, Ct.	1232	4	2138	27 88	250	2 75
" Fluid	114	4	2138	27 88	250	.....
Havre, France	2468	5	3650	11 00	117	1 40
Liverpool, Eng.	10000	4	3620	17 32	180	1 00
Louisville, Ky.	2452	6	2300	.....	200	2 35
Manchester, Eng.	8601	4	3666¼	11 60	150	75
N. Haven, Ct.	896	4	3833⅓	30 00	300	.....
" Naph.	404	4	3833⅓	30 00	300	.....
*N. Y. City	21657	3	3833⅓	.....	100	.....
" Naphtha.	510	3	3833⅓	.....	100	.....
Paris, France.	39129	(3½) 5 (7)	3749¾	(11 25) 15 00 (22 50)	117	2 00
Pittsburgh, Pa.	1653	7½	3650	$20 to $40	175	$1, $2, & 2 50
Philadelphia, Pa.	11981	6	3939	$25 00	200	2 15
Providence, R. I.	2581	4	3648	26 81	225	2 00
Richmond, Va.	1188	5	Moon	Nothing.	150	2 50
San Francisco, Cal.	5212	4	2250	$56 69	....	3 00
Saratoga, N. Y.	280	5	1825	47 00	...	5 00
St. Louis, Mo.	7150	5	2600	37 00	150	2 50
Washington, D. C.	3956	6	2200	36 70	150	2 25
Wheeling, Va.	290	5	Moon.	17 28	350	1 62
Wilkesbarre, Pa.	180	4	Moon	36 00	500	3 00
Yonkers, N. Y.	455	3	3833⅓	33 00	150	2 85

*Prices shown on page 198

Gas as Fuel.

By "Isca.

[Continued from page 201.]

II.

It must be remembered that a given weight of any fuel will always yield the same amount of heat, so that the heat developed, say, from coal, in a common grate, is equal to that which would be given by the same quantity of coal in the largest blast furnace. Similarly, the heat of a lucifer match, or the flame of a tallow candle, is not one whit less than that yielded by an equal weight of wood or tallow burning in the heart of a great conflagration.

No kind of furnace or arrangement of draught can increase the value of any kind of fuel. The only duty of artificial appliances of that nature is to provide for the admission of the necessary amount of air to effect the oxidation of so much carbon or hydrogen, or both, as may be required *within a certain period of time*. The more carbon a combustible contains, the less ready is it to combine with oxygen, and therefore it is found that with almost pure carbon in bulk—as hard coke for locomotives, etc.—the strongest blast is necessary to cause its complete conversion to carbonic acid.

There are only two means by which the quick and complete combustion of fuel may be effected. The first and most useful is to urge a large quantity of air over and through the great masses of incandescent material; and the other method is that of reducing the fuel itself to a state of fine division, whereby its active surface is so much increased that, when intimately mixed with the proper quantity of air, and brought under suitable conditions, the process of oxidation of each particle is effected *per saltum*.

The theoretical reasons for the latter mode of treatment are perfectly sound, but the efficacy and handiness of the apparatus which has been employed to carry them out has left much to be desired; and the practical advantages which have been actually realized are not such as to cause the general adoption of any of the methods which have been introduced for this purpose. It is, however, on record that powdered coal has been perfectly consumed by the admixture with it, in the furnace, of the exact weight of air theoretically necessary; so that it is evident that this desirable object can be attained in the use of fuel in a more suitable form than in solid lumps borne on fire-bars in the usual way. Of course, fuel in this shape can only be used for steam boilers, iron furnaces, and similar trade purposes.

The step from fuel in powder to fuel in liquid form is not difficult. If we agree with the arguments in favor of the former, it must be admitted that they apply with great force to the latter. If continuous firing is of any value—and no one would deny that it is so—a fluid can be caused to flow to any desired point with the greatest regularity, and can also be made to take any desired quantity of air with it. An oil is always ready for lighting, and, when it is first set on fire to the last drop, it can be consumed to its fullest power, and without residue of cumbersome and useless matter. As a source of heat under perfect control, and capable of being used in small quantities and without a furnace, oil has only one rival—in gas; and, in point of portability, it is undoubtedly superior to any other combustible. As long as the oils in common use for illuminating purposes were derived from animal or vegetable sources, their cost was such as to preclude their general use as fuel, for which, indeed, they were not eminently qualified; but the cheapness of mineral oils, not less than their calorific power, has led to their common employment as fuel for certain purposes.

Alcohol has always been in demand as a handy source of heat for small requirements, for which its highly inflammable nature—consuming without depositing soot—renders it very convenient; and although its real heating power is not large, it is readily available. Its costliness, however, even in the form of methylated spirit, is its great drawback.

Bearing these preliminary observations in mind, together with other considerations respecting the comparative suitability of different fuels for ordinary purposes which must occur to every one, the following tabular statement, (next column), compiled from various authorities, of the composition and value of various combustibles in common use, will be found useful.

Some kinds of fuel, but more particularly the solid forms, are commonly found saturated with water, which depreciates their value in two ways—first, by the actual loss of material due to the weight of water present, and bought, it may be, at the price of the dry combustible; secondly, by the amount of heat which that water abstracts from the fuel in being raised to the temperature at which its vapor leaves the furnace with the other products of combustion, and which amount is, of course, diverted from its proper object, and therefore lost. And when a combustible contains oxygen and hydrogen among its constituents, they are considered as being already in the form of water, and therefore it is only the excess of hydrogen, over the equivalent weight which will unite with the whole of the oxygen present to form aqueous vapor, which can be estimated to give any useful effect.

Table of the Average Composition of Fuels.

Fuel.	Components Per Cent. by Weight.							
	Carbon	Hydrogen.	Oxyg'n	Nitr'g'n	Sulph'r	Ash.	Water	Estimated Value in Units per Pound.
Hydrdgen.	.....	100	.....	.....	....	.....	.....	62,500
Carbon	100	.....	.....	.....	.....	.....	.....	14.500
Coal—								
Welsh	83.78	4.79	4.15	0.98	1.43	4.91	.....	14,817
Newcastle	82.12	5 31	5.69	1.35	1.24	3.77	.....	14,776
Lancashire	77.90	5 32	9 53	1.30	1.44	4.88	.....	13,776
Derbyshire	79.68	4.94	10.28	1.41	1.01	2.65	.....	13.841
Scotch	78 53	5 61	9.69	1.00	1.11	4 03	.....	14,136
Averages	80.40	5.19	7.87	1.21	1.25	4 05	.....	14.289
Coke—								
Dry and fresh	92 00	... ...	... ...	.....	0.50	7.50	.....	13 340
Average state	84.75	.....	.....	.....	0.75	7.50	7.00	12,288
Wood—								
Perfectly dry	50.00	5.30	41.70	1.00	.....	2.00	.....	7.312
Ordinary state	40 05	4.20	33.40	.75	.....	1.60	20.00	5,826
Lignite, dry	69.00	5.00	18.80	1.20	.....	6.00	.....	10,661
Peat	45.30	4.60	23.00	1.00	.....	1.80	24.20	7,649
Wood charcoal	92.00	.....	.....	.....	.....	8.00	.....	13,340
Petroleum	85 00	13 00	2.00	.....	.....	.....	.....	20.293
Petroleum oils	72.60	27.40	.....	.....	.....	.....	.....	27,652
Olive oil	77.21	13.36	9.43	.....	.....	.....	.....	18,808
Alcohol	51.98	13.70	34.32	.....	.....	.....	.....	13.402
Tallow	79.00	11.70	9.30	.....	.....	.....	.....	18,042
Beeswax	81.60	13.90	4.50	.....	.....	.....	.....	21,169

The composition of coal gas is so varying with different samples that it is difficult to assign a particular value to it, as may be done in the case of most other combustibles. The following analysis of gas, which is deduced from an example given in the *Journal of the Franklin Institute* of America, for February, 1879, may, however, be taken as a sample of gas as supplied throughout the country; and, not being of very high quality, the total of its heating power will not be open to question as being a too favorable result:

Table of the Proportion by Weight of the Constituents of One Pound of Coal Gas.

Symb'l.	Component.	——	Hydrogen	Carbon.	Oxygen.	Nitrogen.	Heating Power in Units.
H	Hydrogen	.0731	.0731	.....	.....	.....	4,573.4
CH_4	Marsh gas	.4728	.1182	.3546	.....	.....	12,530.8
C_2H_4	Olefiant gas	.1844	.0307	.1536	.....	.....	4,149.1
CO	Carbonic oxide	.1363	....	.0584	.0779	.....	598.0
CO_2	Carbonic acid.	.0716	.....	.0195	.0520	.....	.....
4N+O	Air	.0469	.....	.....	.0104	.0365	.....
H_2O	Vapor of water	.0146	.0017	.....	.0129	.....	.....
	Coal gas	1.0000	.2237	.5862	.1534	.0365	21,851.3

This result closely approximates to the value assigned by Dr. Letheby, which is 21,060 units per pound; the difference, slight as it is, being susceptible of reduction when the lower value assigned by him for hydrogen is taken into account.

It will now be necessary to state the calorific power of coal gas in respect to its *bulk*, that being the basis of its usual conditions of sale and consumption.

Table by Weight of the Constituents of 100 *Cubic Feet of Coal Gas in Pounds and Decimals.*

Symb'l.	Components.	——	Hydrogen	Carbon.	Oxygen.	Nitrogen.	Heating Power in Units.
H	Hydrogen	.23340	.23340	....	.....	.....	14.589.146
CH_4	Marsh gas	1.50835	.37709	1.13126	.....	.....	39,973.252
C_2H_4	Olefiant gas	.58823	.08403	.50420	.....	.....	13,235.629
CO	Carbonic oxide	.48488	.....	.18638	.24850	.....	1,907.620
CO_2	Carbonic acid.	.22846	.....	.06231	.16615	.....	.....
4N+O	Air	.14995	.....	.....	.03332	.11663	.....
H_2O	Vapor of water	.04662	.00518	.....	.04144	.....	.....
	Coal gas	3.18989	.69970	1.88415	.48941	.11663	69,705.647

We can now proceed to draw a few deductions from these tabulated facts.

III.

If the numbers expressing heat-units become cumbrous, as would probably be the case in dealing with any considerable weight of fuel, they may be reduced by dividing by 966, which would give the weight of water at 212° evaporated into steam at 212° ; or, by dividing by 1146, which would give the weight of water at 32°, raised to boiling point and evaporated. Thus, a pound of coal would raise 12.46 lbs. of ice-cold water into steam, while a pound of rectified petroleum would so evaporate 24.13 lbs. of water, and a pound of coal gas would evaporate 19.06 lbs. Otherwise expressed, to raise a gallon of water at freezing point to steam, at atmospheric pressure, would require 0·80 lbs. of coal, and 0·41 lbs. of petroleum, or 8·52 lbs. of coal gas. Or the (apparent) loss of heat due to the proportion which becomes what is called latent, when steam is produced, may be avoided, and in this form we may express the heating effect of a pound of coal to be equal to raising 79·38 lbs. of water from freezing to boiling-point, while an equal amount of mineral oil would boil 153·4 lbs. of water, and a pound of coal gas (which would, with a specific gravity of 0·426 under standard pressure and temperature, occupy 32 cubic feet) would boil 121·39 lbs. of ice-cold water.

But we have seen that the useful effect of coal is reduced by loss of heat by means of ashes, and the difficulty of ensuring its complete combustion into carbonic acid, so that not more than about 60 per cent. thereof is actually available, even in favorable cases ; thus diminishing the weight of water which would be actually boiled to about 48 lbs., whereas the loss in the cases of oils and gas may be considered very trifling, and, in fact, may be almost ignored, especially in the case of gas. Making, however, a slight allowance, it may be stated that the weights of freezing water which could be boiled by a pound of each of these three fuels would be—coal, 48 lbs. ; coal gas, 120 lbs. ; mineral oils, 150 lbs. It must be remembered that each fuel is supposed to be exerting its full average energy under conditions similarly favorable all round.

Under such circumstances, and taking the average cost of the materials in London, the cost of boiling, by one operation, 1000 gallons of water at 32° would be—with coal, 1s. 10½d. ; gas, 9s. 4d. ; mineral oils, 12s. 6d. But these figures are susceptible of much modification when, instead of assuming equally favorable conditions for each kind of fuel, the actual circumstances are taken into consideration. The majority of gas, coal, and oil users do not require to boil such a large quantity of water, and the same prices would not hold good proportionately for fractional weights. Only for oil and gas could such a result be divided with anything like an approach to accuracy, because it is only in the cases of liquid or gaseous fuel that large and small volumes can be burnt with equal facility.

Not that there is no advantage in the combustion of such fuels in large volumes, for it must be evident that, under such conditions, it is possible to utilize some of the heat lost by radiation in warming the air surrounding the flame ; but this advantage is not sufficiently valuable to prejudice the truth of the practically infinite divisibility of fuels of these descriptions, as compared with coal. For instance, although 208 lbs. of coal would boil 1000 gallons of water, it would be practically impossible so to utilize the energy of 2·08 lbs. of the same coal as to boil a gallon of water with it. The comparative sluggishness of its action with oxygen necessitates a certain bulk of the fuel being kept in a state of incandescence, in order that the carbon and hydrogen may be consumed with sufficient rapidity to afford any useful effect. As a matter of fact, it has been found that about thrice the weight of coal above stated would be required, even when a fire is made up for the purpose of testing its performance, and it is not too much to assume that, under ordinary conditions, household fires are kept at least twice as large as in the case of an experiment, in order to avoid the risk of burning low, and to save the trouble of continual feeding. We are, therefore, led to the conclusion that, with slight exceptions, barely one-seventh part of the vast amount of coal which is burnt in the United Kingdom for culinary and other household purposes is really utilized, the remainder being absolutely wasted.

These reflections are based, it is scarcely necessary to state, on considerations of work only ; the question of warming apartments, etc., not entering for the present into the scope of these inquiries.

Returning to the question of the cost of boiling water, which we have taken as our standard of effect, and bearing the above-mentioned observations in mind, we shall find that the ordinary cost of boiling 1000 gallons of water, in small quantities and various times, would be about as follows :—With coal, 13s. ; mineral oil, 12s. 6d. ; gas, 9s. 4d. ; and if to the cost of coal is added that of kindling wood, etc., and the waste which goes on by means of the fire having to be kept up when doing no actual work, in order that it may be ready when required, the disparity is yet greater.

The conclusion to which we are led in the foregoing paragraph is somewhat curious. It could scarcely have been expected that it would be more economical to burn gas than coal, seeing that the one is manufactured from the other, and is sold at a price which has to cover the cost of manufacture and distribution, in addition to the prime cost of the raw material. The advantage to the consumer is to be found solely in the difference in degree of adaptability of the two forms of matter—in the greater facility with which the energy of gas can be made available as and when required.

The competition between gas and mineral oil as fuel is remarkably close. Nothing could detract from the advantages derivable from the portability of petroleum, save the danger attending it when heated, which must always be the case when the reservoir of oil is in such proximity to the point of combustion as is essential to the due development of the heating effect. It is impossible to contemplate the progressive increase in the construction of oil-stoves for every household purpose, and the portentous dimensions to which some already attain, without reflecting on the danger caused by the exposure of such a highly inflammable material as mineral oil in reservoirs —often of slight construction—to the certainty of a considerable and perhaps unknown increase of temperature, and, from the very purposes which these utensils are designed to serve, generally in ignorant or unskilful hands. It is, of course, maintained by the manufacturers of these articles that, with a suitable oil, there is no danger attending their use ; but when a stove of such a description is once adopted in a household, and the carelessness which familiarity brings supervenes, the suitable oil being exhausted, anything which smells like it is put in, and the result is not difficult to foresee.

Digressing for a moment from the main purpose of this article, it is easy to comprehend that the calorific power of mineral oils is anything but an advantage when they are used as illuminants. From the high place which they hold as fuel, it is evident that their use for lighting purposes must be attended with an excess of the heat which is sometimes complained of in gas.

Turning, in conclusion, to the dynamical effects of the combustion of gas, we shall find some curious facts. The energy required to raise a pound of water one deg. of Fahrenheit's thermometer, is capable of raising a weight of 772 lbs. to a height of one foot, or one pound to a height of 772 feet. By the table previously given we find 100 cubic feet of gas will exert a force of 69705·647 units, in other words, is able to raise a weight of 24,023 tons one foot high, or lift one of the gigantic 81-ton guns from the Woolwich Arsenal to a height of nearly 300 feet. Supposing this energy could be developed in one minute, its equivalent in horse power would be 1630. An ordinary gas burner, consuming 5 cubic feet per hour, exerts in that time energy sufficient to lift 1201 tons a foot high, or more force than would be necessary to raise a man of 13 stone to the summit of Mont Blanc. Every minute during which such a burner is alight it is doing work equal to 1·35 steam horses. Supposing, for example, that the consumption of gas in London is 100,000 cubic feet during any minute, the force which such a quantity represents is equal to raising a weight of 718·6 lbs. to a height equal to the distance which separates the earth from the sun ; or the power of 2,112,292 horses is required to light this Metropolis for a single minute of a winter's night.

IV.

Warming apartments is a matter in which individual tastes and prejudices are so mingled with considerations of scientific fitness and economy, that any attempt to deal with it upon the latter bases, without reference to the former, would be attended with failure. It has been demonstrated over and over again, *ad nauseam*, that the English custom of heating rooms by an open fire of coal, in a grate more or less built into the wall, is a grossly extravagant one, and the best reasons have been given, and perfectly unanswerable arguments used, in behalf of stoves of different construction, without altering the system to any appreciable extent. It is true that any improvement in the design or construction of the open grate and its appurtenances is generally appreciated, as may be abundantly proved by reference to the difference between grates after the fashion of even ten years ago, and the most fashionable models of the present time. But the deeply-rooted affection for an open fire is not, with the general public, in the slightest degree modified ; and as long as the cheerful flickering coal blaze is so cherished for the sake of its appearance, as well as for the clear radiant heat it affords, it will probably retain its position in public esteem, until fuel suitable for it shall become so costly as to lend vastly-increased weight to the economic side of the question. There is a certain foundation of truth for the preference shown for an open fire over any system of heating air by pipes or flues, which we will now proceed to discuss and estimate at its probable value, for future guidance.

The heat given out in a room by an open fire is radiant only as distinguished from that obtained from the distribution of heated air, or by conduction in any other manner. Any device for producing the same effect by means of gas must, therefore, act by the same means, for the warmth so derived affects in a peculiar way the human body which is subjected to its influence. Radiant heat is the same as that derived from the sun direct ;

and the brightness and exhilarating effect of a clear sunny day, when its existence is most fully manifested, has only to be compared with the languor and depression experienced in cloudy, sultry weather, when the atmosphere has been heated by contact with a parched earth, for the mind to be convinced of its superiority, although the reasons for it may not be understood. Briefly stated, air is not affected by radiant heat, so that heat rays pass through it to the cold object which attracts them, without suffering loss of power; a human body, therefore, feels comfortably warmed by them while breathing air quite cool and refreshing. This curious property accounts also for the "rawness" of the air so frequently complained of in spring, when the sunshine feels quite hot. And it is a provision of great beneficence for the inhabitants of the globe; for if the atmosphere were capable of being directly heated by the sun's rays, it would attain the withering temperature of a blast furnace; while the rush of colder air from those portions of the earth's surfaces which happened to be in shadow, would cause hurricanes so violent as to render life impossible, even if the heat could be endured.

Now, the difference between the sensation experienced by the human body in a room warmed by the radiant heat of a coal fire, in contrast with that produced by previously heated air, is this: In the former case, the body receives warmth from the fire, and the walls of the apartment, being subject to the same influence, do not attract an undue amount of heat from the body. The body, therefore, is only cooled by the contact of air, which, from the property before mentioned, is cooler than the walls, etc., of the room. Now, under ordinary circumstances, this cooling agency is very limited in its action; and as, for equal differences of temperature between (*a*) bodies exposed to radiation, and (*b*) bodies exposed to contact of air, the thermal change is greater in the former than in the latter, it follows that when both are in operation at one time, as in the present instance, the balance is in favor of the heating influence, and the body is accordingly at ease.

On the other hand, when the air is hotter than the walls, the circumstances are entirely reversed. The walls and other objects in the apartment now abstract heat from the body, which only receives warmth from contact with heated air; and, from the comparative feebleness of air in imparting heat, which is commensurate with its power of abstracting it, as in the former case, it is necessary, in order to counteract the loss of heat by the body to the walls, etc., that it should be raised to such a temperature as to cause, by its consequent rarefaction, an unpleasant amount of labor in the respiratory organs. Hence the preference shown to systems of heating apartments intended for human occupation, by direct radiant heat, or such modifications of it as may tend to secure its most important characteristic of warming objects in a cool atmosphere.

However objectionable it may be to introduce hot air into places in actual human occupation, it is perfectly allowable to warm the walls, etc, by contact of heated air, previously to their being inhabited, and then providing cool ventilation. This may be well done in public halls, churches, etc., which are only occasionally used. The advisability of such expedients for supplementing direct radiation is evident when it is remembered that only about half the heat of incandescent fuel is radiant, the remainder being carried off by the products of combustion, including the air drawn into the chimney. In an ordinary room a small proportion of this is doubtless absorbed by the chimney breast, and thence given off into the room; but its value is small.

If the necessity of utilizing the heat of the fire, other than that which is radiant, is apparent in the case of solid fuel, much more is it so in treating of gas. In fact, when gas is burned under those conditions which develop its heating energy in the most complete degree—that is to say, by previous admixture of air, as in the Bunsen burner—the amount of heat radiated is extremely small, almost the entire effect being concentrated in the flame itself. Hence, in dealing with the question of warming rooms, etc., with gas, we are met at the outset with the difficulty, that its peculiar nature renders its action least directly efficacious for the required purpose exactly when its inherent power is most conspicuously exerted.

The real object to be attained by all gas-stoves intended for heating purposes direct, as distinguished from those constructed for heating water-pipes, etc., is to transform the heat of the flame into radiant heat—a problem which should not be insoluble. This, of course, is a very different thing from merely reflecting the radiant heat actually developed by burning gas in the usual way, as for light. That is really only making use of a fraction of the possible energy in the true direction. What is wanted is, first of all, to get all the work possible from the material, and then dispose of it in the proper manner.

In some European countries, where the winter is extremely rigorous, houses are warmed throughout at an expenditure of fuel which would scarcely maintain for one hour the open fire in an English drawing-room. This assertion has been made so often, that, as was observed in the beginning of this article, it is trite and disregarded. But the means whereby that effect is produced may throw a light upon the question at issue, and, if, so, it may be well to try yet once more to teach an acceptable lesson from other people's example. In every room stands an earthenware stove, which, from its size and appearance, is often the most important article of furniture in the apartment. Often it is of fine porcelain, beautifully colored and modelled—a veritable work of art as well as of great utility. When the exterior temperature is at about zero, a handful of lighted charcoal is put into the stove, and the heat therefrom is given out with mild radiance from every part of the structure, the power of porcelain in this respect being superior to that of iron or copper, while there is a total absence of any objectionable smell like that of heated metal. Its height being great, the flue adds considerably to the total effect, as the products of combustion pass away at a very low temperature. The fuel burns very slowly, and, consequently, for bedrooms or halls, where little attention is possible, there is not much danger of the fire going out, which is an advantage that must be allowed to this system by the strongest advocate of the open grate, and is something which also may be claimed for gas, to an unrivalled degree. And it appears feasible to conduct, by suitable appliances, the heat of a Bunsen burner to the surface of stoves of similar construction to these, for charcoal, and so to obtain the nearest possible approach to radiant heat, without the necessity of exposing actually glowing fuel.

Without pretending to lay down the detailed design of heating stoves upon this principle, it may safely be stated that there is room for experimental research into the efficiency of apparatus built upon the lines above indicated, of complete combustion, careful transmission, and ample area for radiation; and it is probable that the earthenware stove of great height will be found to give more satisfactory results than any other model.

In heating greenhouses, conservatories, etc., which are commonly built in chief part of glass, and are not primarily intended for human habitations, another and simpler question is presented for solution, and consists almost solely of the necessity of heating the confined air, and that which finds its way into the interior through the crevices of doors and windows. The walls are, in such cases, incapable of storing heat, and the cooling influence they exert is simply by means of conduction to the exterior—a process capable of tolerably accurate estimation. Hot water pipes are almost universally employed as the agents for maintaining the required temperature of such places, and are so arranged in a circuit that the water, having become cooled by the distribution of its heat, returns to the boiler for a renewal of its energy. The problem is thus resolved into a matter of heating a certain weight of water through a range which is usually limited by the fact that while the water must not be allowed to boil it should not be cooled much below 170° Fahr., in order to take advantage of the distributing power of pipes at high temperatures over those at but slight differences between their surfaces and the surrounding air.

We have seen, in earlier portions of this inquiry, that gas is endowed with great power as regards heating water, and its regularity of action, and the ease with which it may be controlled, render it particularly suited for such a clearly defined duty as that of heating a circulating boiler. Coal, or any solid fuel, is very ill adapted for, in most cases, from the peculiar shape of the apparatus employed, only its radiant heat can be utilized, which is only half the effect it is capable of producing, and a great proportion of that is wasted, while gas can be caused to exert its utmost power under similar circumstances. It will consequently be near the truth if we assume that the comparative performance of coal and gas in circulating water, and the cost of each kind of fuel, will bear about the same ratio as was found in Section III. of this article to obtain in the case of water otherwise heated in small quantities. But there is one aspect in the present question which shows the advantage of gas under conditions which place it beyond the power of any kind of solid fuel to compete with it, and that is the possibility of making good use, by its assistance of circulating apparatus of the most diminutive proportions, or to reduce the activity of larger systems to a point at which it would be impossible to keep a fire alight without the consumption of so much fuel as to render any attempt at comparison of results entirely supererogatory.

For instance, a 2-inch pipe, at a mean temperature of 190°, in air at 60°, will dissipate 177 units per foot run per hour, which will suffice to raise 9777 cubic feet of such air 1° in that time. Or supposing, for example, that it is required to maintain the interior temperature of a small greenhouse, 12 feet long by 10 feet wide and 8 feet high, at not less than 60°, while the thermometer stands at 50° outside; the loss of heat by such a structure will be for 1° of difference=0·306 unit per square foot of exposed surface per hour, or for the assumed difference of 10°=3·06 units; and the superficies being, say, 480 square feet, not including the floor, the total loss will be 1468·8 units per hour by radiation and contact of air. And if we further assume that by leakage, etc, the contained air, =960 cubic feet, is entirely renewed within the hour—which means that 960 cubic feet of air have to be raised in that time from 50° to 60°, or an additional requirement of

960 × 10 × ·238 = 2284·8 units (the last factor being the specific heat of air)—adding the two, we shall have 3753·6 units to supply per hour, which would require, as above, nearly 22 feet run of 2-inch pipe, and the necessary heat would be produced by the consumption of 5·4 cubic feet of gas. Allowing full value to every source of waste, the consumption of coal to do an equal amount of work should not be more than about 1 lb. It is palpable, then, that no useful effect could be extracted in practice from such a sluggish combustion, even if it were possible to keep such a small fire going at all.

Examples of this nature may be multiplied to any extent; but enough has been done to show the incontestable superiority of gas, under certain circumstances, as a source of heat, for systems of hot water circulation.

Before leaving this branch of our subject, we may indicate the use of enclosed hot water pipes for warming the walls of corridors, staircases, etc., as a convenient means of maintaing a comfortable temperature, similar in character to that of direct radiation, with great economy of force, which may be most conveniently derived from gas.

There is a great future in store for gas as fuel, and many devices will be tried before the best means of using it will be authoritatively decided. But one word of advice may be offered in concluding this article, and that is—let the *effect* required in all cases be clearly understood, and then let the appliances for producing it be intelligently devised. More particularly is this observation intended to apply to heating houses and similar places where the measure of success is judged from a standard of far greater delicacy than a thermometer. Let not a mere appearance be a guide, nor attempt to imitate the *look* of a coal fire, without reference to the peculiar work it is capable of doing. Two agents may do the same duty, but not outwardly resemble each other in the least. If one works as well as, or better than the other, it will rival or supersede it on its merits, and the accidents of its appearance will become familiar and possibly favored; while the inferior one will never gain acceptance by aping the form of the other. Beauty is never secured when it is sought as an end; but fitness is instinct with beauty, and when the first is attained, the existence of the other is soon perceived and understood.—*Journal of Gas-Lighting.*

Flame-Spectroscopy *

The various kinds of flame most frequently employed to render substances incandescent in spectroscopy are—

1. The alcohol lamp.
2. The Bunsen gas burner.
3. The coal gas blowpipe driven by air.
4. The coal gas blowpipe driven by oxyen.
5. The oxy-hydrogen blowpipe.

Of these five kinds, I choose the middle one as a stand-by, for while its pointed conical flame is more definite, precise, and workmanlike than the wavy, loose flames of the first two, it is cheaper, more usually met with, and more frequently ready for acting than the two latter; while it links us on to a very fair amount of heat for any flame-work, or what we may consider a standard step in temperature throughout all these researches. The above coal gas and air blowpipe has, moreover, the further recommendation that, dull as its blue grey flame may appear to the eye, yet it contains several colors which separate into distinct, discontinuous bands under the spectroscope; and they would probably be more often utilized for spectroscopic science if they could only be made decidedly brighter. But brighter it must be without any change of temperature, and also without our losing the use of the simple open flame to vaporize at pleasure adventitious and external matters in the usual flame spectroscopic manner.

Prof. Swan, of St. Andrews, who first gave a large, scientific, and, indeed, very noble account of this blowpipe flame and its spectrum, and gave it so far back as 1856, was so impressed with the importance of brightening, if possible, its faint bluish light, that he placed three small blowpipes (of his own ingenious making), one behind the other, and looked through all three at once. Thereby he was enabled to measure all the leading details of four out of the really five colored bands in this spectrum; but failed to see the lines in the first of these as to position, viz., the orange amber band.

After him several observers in London, Paris, and Manchester recurred to single or double blowpipes, but, unfortunately, in conjunction with pure oxygen gas; for by that emphatic addition the temperature of their flames was so greatly raised that they are all necessarily excluded from the present inquiry.

More recently I have obtained a copy from Paris of the late Padre Secchi's grand work entitled "Le Soleil" (2d ed. 1875); and on p. 246 of vol. I., where that brilliant scientist has introduced, though without acknowledgement, a copy of my own Edinburgh Observatory sketch in 1872 of the whole five bands of the simple blowpipe spectrum, he yet, in alluding to it in the text, speaks of the bands as being, in all ordinary cases witnessed by him, *three* only, and their colors "green and blue"—really citron, green, and blue; in which case he could only have seen the three brighter ones of the five.

In. Prof. Roscoe's well-known volume of "Lectures on Spectrum Analysis," (1st. ed. 1868), there is a colored representation of the coal gas spectrum with five bands, and some of them with lines, not, perhaps, intended to be very accurate, but most assuredly not indicating the slightest appearance of any lines in the orange-amber band. The 3d edition of 1873, which I have just referred to, contains, at page 320, the same plate.

A more advanced style of pictorial representation is that contained in Plate III. of M. de Boisbaudran's admirable, in most of its plates unequalled, if not inimitable, work entitled "Spectres Luminnex," (Paris, 1874). Plate III. purports to represent the spectrum of the blue flame of coal gas. Our five colored bands are of course represented, but the lines, marked only in the citron, green, and blue bands, are broad and hazy; the observation having been confessedly made with a slit that was "not very narrow," and there are no lines at all on the very faint orange-amber band. Nor are there any records of such things among the numerical measures—though the existence of four lines is mentioned in an appendix as having just been seen when both a very strong blowpipe jet was employed, and some extraneous matters introduced into its flame, with the effect of considerably condensing it.

Such was the state of this question when, last winter, after trying many experiments with plain and simple coal gas and air blowpipes (the coal gas being merely taken out of the service pipes of the house, and the air driven through its flame out of an india-rubber bag, with a pressure of two or three inches of water), it occurred to me, remarking the narrow but elongated figure of the brighter part of the flame, viz., about ¼ of an inch in diameter and 2 inches long, to try looking at it end on, in place of, as almost every spectroscopist has hitherto done, transversely to the axis of the flame, and of course quite close up to it in both cases. The result, without any other change, was almost magical;* not only were five bands at once most brilliantly seen as to their colors, but the six or seven lines in the first of them or the orange-amber band, hitherto only uncertainly made out by any one, were now the most beautiful series in the whole spectrum. Next the lines in the citron band showed themselves splendid for brightness, and the number of them, toward their vanising side, much increased. In the still brighter green band, the first line stood forth in a manner to well deserve its quaint, Alexander Herschel title of "the green giant of carbo hydrogen." The lines in the fainter blue band were yet admirably distinct, though closer than the others. And in the violet band, though no similar lines exist there, the distinction of the faint band, the strong band, and the one fine line between the two, was also well made out.

So much appeared with a very moderate prism-power on the spectroscope; but on applying a dispersion equal to 22° between A and H, or five times as much as might usually be employed, I gazed for a time in mute admiration on the scene then opened up. Such a scene of ——; but, if you please, before I begin any attempt, which can hardly but prove weak and poor, to set before you some idea of what the really entrancing feature of that vision was, allow me just a minute to state why this particular spectrum is thought so very important, and is so very much sought after.

Wretched as may be the more publicly illuminating power of a grey blowpipe flame of coal gas and simple air, it is the standard representative in spectroscopy of nearly half nature that does not, and nine-tenths of nature that does burn. By day the spectroscopist, however far he may travel in the spectrum, from ultra red to distant lavender grey, can always find out whereabouts he is by referring to the solar lines as seen either in the sun itself, or in his marvellous quality of light as reflected from blue sky, or a cloud, or a hill, or a house, or from snow, or from anything whatever which reflects any daylight at all. But at night, when there can be no such light to reflect, and the last of the gloaming is gone, and there may be no moon or planet, the young spectroscopist is either lost in darkness or bewildered on a chromatic ocean without fiducial marks of any kind. For though he turns to the light of a lamp for aid, or to any one of a thousand gas lights, their bright flame—bright from the incandescence of little solid particles of carbon—offers, like all other incandescent solids, only a continuous spectrum, wherein the colors blend indistinguishably one into the other, from the red through the citron to the violet. Hence the poor youth at night would have been altogether at sea, when spectro-

* By Piazzi Smyth, Astronomer Royal for Scotland, and Past President of R.S.S. Arts. Read before the Royal Scotish Society of Arts, Feb. 10, 1879.

* This increase of the first expected effect was owing to the hollow nature of flame, and the superficiality of its light. So that when viewed end on, the whole of the illumination previously seen in the long side profile was not merely confined to a disc equal in area to a cross section of the flame, but was further concentrated into a thin circumference of that disc.

scoping something new in heaven or on earth, had not our excellent Fellow of former years, and still only removed by the breadth of the Firth, Prof. Swan, shown that all the substances hitherto used by man for artificially illuminating the darkness of night (such as wax, oil, tallow, turpentine, ether, alcohol, generally carbo-hydrogens)—all of them give, in the blue base of their flames, one and the same spectrum of but five colored bands and their several innate half-dozen or so of lines; the same spectrum, in fact, as that of the flame of our favorite blowpipe, though that instrument gives it more neatly, clearly, and without the swamping effect on its best characteristics of the dense continuous spectrum derived from the more or less yellow light in the upper parts of most kinds of simple lamp flame.

Now I had for a long time, when voyaging in the Mediterranean, actually used an alcoholic lamp with a flame made purposely long and thin, in order to develop its blue base and hide its yellow top,—I had, I say, employed those carbo-hydrogen spectral lines as given by alcohol, for reference in Aurora and Zodiacal Light spectroscopy. But I gave it up at last on finding how much cleaner and freer from apparently adventitous haze the selfsame bands and their lines appeared in the blowpipe flame of coal gas* and common air. And yet the lines did not appear even there without any haze at all! In fact, there was still so much of it hanging to them, and interfering to such an extent with the easy visibility of some of the fainter lines, that I am afraid in my haste I thought it a nuisance, an abnormal interloper, and held it as mere trash to be got rid of in any possible way. But it would *not* go; and now, on looking once again at the old green band and all its plaguing haze, made denser than ever by the brightness of the end-on view, but on this occasion *extra analyzed, or spread out, by the tremendous dispersive power just described*, behold! all that haze, instead of becoming more hazy and diffuse than ever, was resolved neatly and perfectly into innumerable exquisite fine lines or linelets! These miniature lines of light, indeed, filled the whole field of view; asserted themselves to be as necessary to the spectrum of coal gas and air as any other part of it, and had, besides, a beautifully regular progressive arrangement of their own, gradually increasing in distance assunder, as the older band lines—now looking like hugh and far-between Cyclopes—decreased in theirs, as they all tended on, in the direction of increasing refrangibility, toward the violet.

Something of the same kind, and even more distinct in many of its details, has already been seen, I am aware, by many other persons, in certain spectra both of oxygen blowpipes and electric sparks; but those spectra have greatly elevated temperatures, and I am confining myself here, for the reasons already stated, to simple coal gas and atmospheric air blowpipes only. And not so much even there, to what may be done absolutely by increasing their size immensely, as in Prof. Roscoe's blowpipe with "a blue flame 3 feet long;" but to the differential effect of looking at one and the same blowpipe flame, whether large or small, first transversely, and then end on.

The improvement, too, of vision for spectroscopy by the end-on method is so decided, and at the same time is obtained so simply and economically, or without any increase of expense whatever, that it would doubtless have been adopted everywhere long ago, and not left for me to advocate, had not the chemists, a large and influential body of men, and to whom we all owe much (yet said, in former times, if not still, to positively rejoice in living in the midst of flames and smoke and soot)—if, I repeat, the chemists had not so generally kept to their sad, dirty plan of letting their salts burn and fizz in a flame close in front of the naked slits of their spectroscopes.

Hence Mr. Rand Capron, in his "Photographed Spectra" of chemical elements, following lately the supposed orthodox method, finds himself compelled to write—"Much trouble was experienced in keeping the slit-plate clear from metallic beads and other impurities." And he suggests that in future it would be a great advantage to have the whole slit-plate gilded, and the slit-jaws formed of obsidian, platinum, or gold. Vain resource, however, if the spitting flame be still preserved close by, and quite inapplicable to any end-on use of it; for that would imply directing the full blast of the blow-pipe right on the slit-plate and melting it down altogether. But my rude spectroscope having been built up at home, and primarily for operating on the distant light of the Aurora, as seen occasionally from an upper chamber at No. 15, Royal Terrace, Edinburgh, I was compelled from the first to bring such very far-off light to the slit by an anterior image-forming object-glass. And once having made experience of that excellent method of using an optical image of the thing, and not the thing itself, especially when that thing is worse to touch than a red-hot poker, have kept to it ever since for table work close by, as well as celestial objects a long way off.

The above, therefore, removing the last of the practical difficulties in the way of any one desirous of enjoying the advantages of end-on illumination in his flame spectroscopy, I close this part of the paper by referring to the Appendix for the following tables of useful data:—

Table 1. Colors of the spectrum by spectral place.
" 2. The blowpipe flame's spectrum, seen *end-on* under small dispersion.
" 3. Certain parts of the blowpipe flame's spectrum, under higher dispersion.
" 6. Wave-number places of certain practical data.

—*Chemical News.*

* At a distance from gas supplies, it is well to know that an equivalent to coal gas for the spectroscope, and perfectly safe, may be procurred by passing a stream of air through a vessel containing a considerable surface of benzine or other hydrocarbon liquid in a vaporizing condition at ordinary temperatures.

Exhibitions of Gas Apparatus.

Attempts are now constantly being made to popularise gas and its applications, and not before it was necessary in our opinion. Hitherto gas has been looked upon with something akin to fear, and by many its use even for lighting purposes was objected to as a dangerous and unhealthy agent. The gas suppliers are more to blame for the spread of these false notions than the consumers. The gas is manufactured, and as soon as it reaches the meter, the companies, as a rule, lose all interest in it, with the exception of a few places in the north of England. They care not how it is consumed, how it is wasted. They offer no inducement for a more extensive or varied use, and, beyond the examination of the meter at stated intervals, never look to the fittings, nor trouble themselves about any of the internal arrangements.

Such a method of transacting their business is unsatisfactory both to the company and their consumers. It is well known that if gas be improperly burned, not only is the maximum of light not obtained, but the products of combustion are unpleasant and ofttimes injurious. There are many arguments against gas companies becoming their own fitters, but the most potent one is the unfairness of the monopoly. When this term means looking after one's own interest, which are otherwise neglected, we fail to see the unfairness. It is evidently the interest of both parties to supply and be supplied with the apparatus most likely to use the gas to its best advantage, and this ideal, which may at present savor of Utopia, can only be brought about by the companies supplying, not only gas, but the proper apparatus with which to burn it. No doubt we shall bring a wail of discontent on our heads from a numerous company of plumbers and noble army of gasfitters; they will most likely exclaim with Othello, that their occupation is gone! but let them *bide a wee and tak' a thocht*, and they will find that things are not so bad from their own point of view as they seem at first blush. Supposing the charge we are advocating to take place, would the work of the gasfitter be less? It must be admitted that at least the same amount of work would have to be done as at present, and it is more than probable that, under the supervision of the practical men which the companies would have to employ as inspectors, a good deal more would be found necessary. This increase of work could not be met with the staff of workmen usually employed, and gasfitters would find that, instead of having no work to do, they would have in reality more than formerly. No one but a practical gas engineer can possibly know what size of a pipe to lay in a house, so as to be suitable for any particular volume of gas passing through it. The question of the best form of burner has already been alluded to in our columns. It must be admitted that the gas manager is the most capable man to advise as to the most suitable burner from which to burn his gas. We have, no doubt, digressed somewhat from our subject in alluding to this question, but there would have been no necessity for so doing if the general body of gasfitters had made their customers better known with the properties of the gas they were burning, instead of keeping them in happy ignorance, which meant profit to themselves and loss to their customers. Such exhibitions, however, as the one now being held at Leeds will do a great deal to sweep away many of the supposed disadvantages of gas supply, and will show to those that most need it what a valuable and useful agent they have at command, one which if properly managed is capable of giving both light and heat, and can be utilised for any domestic cooking requirement, or serve as a motive power to the mechanic. Scotland has been slow to see the advantages likely to accrue from such a show, as, although several have been held in England, there are at present no signs of any such advantage being offered to the gas consumers of Edinburgh or Glasgow. We have in Edinburgh suitable buildings for such an exhibition, and if one were opened it could not fail to attract large numbers of spectators. A small sum might be charged for admission, and it would at once prove a remunerative as well as a useful undertaking. Not only should opportunities be given for inspection, but lectures should be arranged so that the various apparatus might be explained by thoroughly competent and practical men. We hope the day is not far distant when we shall see some sign of Edinburgh following the example of sister towns who have not advanced so far on the scientific ladder as herself, but who seem to have more energy in turning what knowledge they do possess to some ac-

count. If such exhibitions had been more common than they were before the electric light scare there would not have been such a panic in the gas share market. The capabilities of gas would have been better known, and electricity instead of causing a fall would have been more likely to cause a rise, for the public would have known that as much light could be given by gas at one-seventh the cost of electricity.—*Journal of Artificial Light and Sanitary Gazette.*

The Law of Demurrage.

A point of considerable interest has been decided by Judge Blodgett, in Chicago, in the admiralty case of John Spry, owner and master of the schooner "Ellen Spry," against 997 tons of coal, to recover some $600 damages for demurrages. The vessel arrived one evening last fall on her last trip up with a cargo of coal consigned to J. L. Hathaway, but owned by Reno & Little. The master at once notified the consignees of the arrival, and a dock was asked to be provided her to unload within the twenty-four hours provided by law. As nothing was done at the expiration of the twenty-four hours, Spry served a notice on Reno & Little that he should charge $100 a day demurrage for any delay which might occur. During the five days the schooner was lying there freights rose rapidly to 4¼ cents a bushel on corn, and the evidence showed that had the schooner been unloaded within the ordinary time she could have secured a cargo at that rate. By the time she had unloaded, however, freights had fallen to 4¼ cents, and she took a cargo at that rate. She, being a 40,000 bushel vessel, suffered a loss of $200 on the freight. Commissioner Proudfoot in his report allowed the owner $300 damages, being $200 for the loss on freight, and $100 for three days' extra detention. Exceptions were then taken to the report.

Judge Blodgett held that the notice given that the owner of the "Spry" would claim demurrage for the delay was not, under the law, sufficient notice to hold the cargo, after delivery, subject to a lien in rem. That the master or owner should, at the time of delivery of the cargo, have notified the consignees that he would consent to deliver the cargo only on the understanding that he insisted on his lien for the demurrage. The Court held that if any right of action existed for the demurrage it was a personal action against the consignees of the coal. For want of the notice in question, the Court held that the owner of the vessel had lost his right of lien against the cargo and dismissed the libel.—*Coal Trade Journal.*

Backing up the Eddystone Lighthouse.

The following has been addressed to the Institution of Mechanical Engineers, London. The writer, who dates from Nelson, New Zealand, requests us to publish it.

In "Chambers's Journal" of May 31, 1878, the fourth paragraph in the article "The Month, Science and Art," reads thus:—"The Institution of Mechanical Engineers has published its usual yearly list of subjects on which the members would be glad to have papers for reading at their next meeting, etc." The fifth is as follows:—"One of the subjects is improvements in the Lighthouse, by which we are reminded that a new lighthouse at Eddystone is talked of. The present structure was built by Smeaton in 1756–59, and ever since, as long before, as indicated by name, the sea has been wearing away the rock on which it stands, and now threatens to undermine the foundations. The tower would be built on an adjacent rock, with, as we may believe, all the modern improvements in construction and lighting."

When I read the foregoing paragraphs I was a great deal surprised that such a wearing away should have been permitted to go on for so long without attempts being made to stop it and preserve such an immensely beneficial structure from certain destruction, which, if permitted, would cause so large a loss of life and property before a new one could be constructed, that I shudder to think of it. When I know your Institution, and many other kindred ones, contains so many clever and ingenious engineers and scientific men of repute, I wonder some should not have hit upon a method of stopping the wearing away of that rock; yet the thing is very simple, and when once done will thoroughly resist any power of the sea, under any circumstances, forever. If it was not a matter of such immense importance to the maritime service, not only of English, but of all other nations, I would not have ventured to intrude.

The innumerable experiments that I have made with coal tar, in order to utilize it and find out its combinations with other materials, to make what is known to the scientific men as asphalte, show the following proportions are the best: coal tar, 10 gallons; sifted slack lime, one peck; the tar and lime to be mixed together first in all cases.

If gravel or rubble is saturated with the above mixture—the former in all cases to be thoroughly dry—I call that asphalte concrete; if fine sand is mixed with it, that I call asphalte mortar.

I think all the members of your Institution know well that the above material is perfectly impervious to the water; therefore, if let down into the water it soon become a solid mass, resisting all the power of water as well as atmosphere. Any wall built with good stone and asphalte mortar is, without doubt, an everlasting wall. I have arrived at the above conclusions after many experiments and immense labor, both physical and mental. Therefore I am perfectly satisfied that if asphalte concrete is let down on the western, south-western, and southern sides of the rock on which the Eddystone Lighthouse now stands, to such distance as may be deemed necessary, it will assuredly stop the wearing away of the rock, and if the present tower is good, or not damaged much, I would respectfully recommend the adoption of the above plan, instead of building a new tower on the adjacent rock, which I know personally is not well suited to the purpose, besides entailing an enormous expense.

If the asphalte concrete plan is adopted, it must be borne in mind that the greater the amount of tar is used in saturating the gravel, the more it spreads out at the bottom, and *vice versa*; but it has the advantage that it becomes all the more solid and cohesive to resist the attacks of the waves and time. And, if the preservation of the rock and the present tower is decided on, I would recommend that an additional strength be given to the tower by surrounding the lower part with masonry, oversailing toward the top. The stones should not be large, but of good quality, and well jointed on the outside face, and well bedded in asphalte mortar. The object of it is two-fold; the one to strengthen the tower, the second to save the force of the waves against the structure, and prevent the wash-up to the upper part of the tower and the lantern.

If the stone of the tower above the proposed addition should show looseness—I mean, if the cement has been vitiated by the combined destructive agencies, the atmosphere and water (which is always the case in course of time)—I would advise the decayed mortar to be scooped out about two inches, then the joints well filled with fine asphalte mortar, using little more lime than the above mixture.

I have found the above-named asphalte concrete the best and cheapest for stopping the encroachment of a river on its banks; thus scoop the bank to about 45 degrees, then cover with asphalte concrete from 6 inches to 1 foot, using rather wetter for the bottom. If it is thought that the bank is likely to be undermined, dig a trench as deep as can be for the water, use fine gravel and well saturated for the bottom; so, likewise, if the water is deep alongside of the bank.

The same material can be used for many other public works, such as culverts, abutments, and piers of bridges, facing them with stone at the angles of abutments, and at the end of the piers lay boulder stones out of the stream with course asphalte mortar, and with concrete inside from one to two feet in thickness, according so the height of the work. Arched bridges can be built with the same, by making a rough frame for arches and the sides, using the biggest boulders for the arch, the small end downward. Let the frame remain till it rots away. The asphalte will have hardened to bear any weight, and will last forever.

I maintain that all the work that is done with the asphalte concrete and mortar will be almost everlasting, as no water nor atmosphere under any circumstances has any destroying effect upon it, of which any of your scientific members can satisfy themselves by experiments. ERICK ORR.
—*London Builder.*

From the "London Builder."]

The Night Lights of Old London.

GAS.

Although the primitive days of lighting London practically expired with the introduction of gas, when, threescore and ten years ago, the first application was made to Parliament to sanction its use as a new illuminator for the thoroughfares of the metropolis—yet it must be borne in mind that the "new light" was really known a century earlier, and only wanted science to help to make the wonderful discovery useful. How science had to combat with public opinion we shall presently tell, and it will be seen that even in the vaunted days when George III. was king, there was as much prejudice in the minds of the human race against gas as ever there is likely to be against the electric light. And is it to be wondered at, seeing that it has taken eighteen hundred years to bring into existence most of our inventive faculties, and that the vast majority of all our discoveries and inventions have been brought into practical use within the last threescore and ten years of the Christian era!

We have already shown that the night lights of Old London consisted successively of candle wick and oil, and that the streets continued thus illuminated down to the commencement of the present century. There are some of our friends old enough to remember the dim oil lantern which shed its mocking light across their path as they trudged home during the eventide of those days when railways, steamboats, gas, and the telegraph were unknow to the people of London. And although many friends will call to mind the

commencement of gas lighting, there are many incidents connected with the new illuminator's early days which will be new even to the best informed in such matters.

The discovery of gas, like many other discoveries, arose by mere accident, and not by a series of experiments. Miners had known of the inflammability arising from coal gases long before the days of the Royal Society, but it had never occurred to them to utilize it. Such a feat was not attempted until the dawn of the present century. The earliest account of the discovery is to be found in the "Philosophical Transactions" for the year 1667, and is quaintly headed "A description of a Well and Earth in Lancashire taking fire by a Candle approached to it. Imparted by Thomas Shirley, esq., an Eye Witness."

The writer tells us he was returning to his house at Wigan in February, 1659, when he was informed that the water in a spring in Mr. Hawkley's grounds, about a mile from the town, on the Warrington and Chester road, was burning like oil. Whereupon he and half a dozen friends proceeded to the spot, and applying a burning candle, the water gave forth a flame at a particular spot, but not in the ditch which ran from the spring. Neither did the water burn when taken up in a dishfull, although "the water at the burning place did boyle and heave like water in a pot upon the fire, though my hand put into it perceived it not so much as warm." This led Mr. Shirley to look minutely into circumstances,. "The boyling I conceived to proceed from the irruption of some bituminous or sulphureous fumes, considering this place was not above thirty or forty yards distant from the mouth of a *coal-pit* there. And indeed Wigan, Ashton, and the whole country for many miles compass is underlaid with coal. Then applying my hand to the surface of the burning place of the water, I found a strong breath, as it were a wind, to bear against my hand." Whereupon, says he, "I caused a dam to be made, and thereby hindering the removal of fresh water to the burning place, I caused that which was already there to be drained away; and then applying the burning candle to the surface of the dry earth, at the same point where the water burned before, the fumes took fire and burnt very bright and vigorous."

Although this discovery was deemed of sufficient importance to occupy a place in the Royal Society Transactions, nothing further was printed until 1733—that is, 66 years afterward—when Sir James Lowther, having occasion to sink a pit for draining one of his principal collieries, near Whitehaven, we are told that "a vast quantity of damp corrupted air, which bubbled through a quantity of water spread over a part of the pit, and made a great hissing noise, at which the workmen, being somewhat surprised, held a candle toward it, and it immediately took fire upon the surface of the water and burned very fiercely." Of course, the workmen were considerably alarmed, clearing themselves at once from the pit, "having first extinguished the flame by beating it with their hats." After further details, the writer states that this damp air, being put into a bladder and tied close, was carried away, and after some days was "pressed gently through a small pipe into the flame of a candle, took fire and burned at the end of the pipe as long as the bladder was gently pressed to feed the flame, and when taken from the candle, after so lighted, continued burning till there was no more air left in the bladder to supply the flame."

Here, then, we see the principle of the present gas light explained in a few words—and this was nearly a century and a half ago. But before 1691, the Rev. Dr. Clayton, the Dean of Kildare, had written to the Hon. Robert Boyle a letter, in which he calls gas "the spirit of coal." The manuscript is preserved in the Sloane collection, but was printed in the Philosophical Transactions in 1739. Dr. Clayton enters fully into the method of compressing the inflammable air into bladders from a reservoir, and then pricking a hole in the bladder with a pin and putting a lighted candle to the opening, which "at once took fire and continued burning until all the spirit was compressed out of the bladder." And yet it was only occasionally that men of science woke up to test the peculiarities of "the bubbling flame" and "spirit of coal." In fact it was not until 1792, a century and a quarter after the publication of Shirley's discovery, that the importance of gas was demonstrated as a means of lighting, by none other than William Murdoch, at the out-of-the-way end of England—Redruth, in Cornwall. After many experiments he lighted up his residence and office, not forgetting a portable bladder, by which he lighted himself and his carriage as he passed along the Cornish roads. Long after he had left the district, amusing tales were told of the Redruth magician and his wonderful light, and the consternation of the natives may be easily imagined, but cannot be described. Removing to Birmingham, Murdoch tells us he constructed, at Messrs. Boulton & Watts's factory, at Soho, "an apparatus upon a larger scale, which, during many successive nights, was applied to the lighting of their principal buildings," by which, he adds, "I may, without presuming too much, claim both the first idea of applying and the first actual application of the gas to economical purposes."

This was in 1798, at or before which date he had proposed to Mr. Watt to get a patent, "but the actual wisdom of which proposal Mr. Watt did not agree with. Any way, the experiments at Soho cost the firm more than 4,000*l.*, and in March, 1802, at the celebration of the Peace of Amiens, the Soho factory made a general illumination by means of a rod, forty feet long, and a burner at each end, which was, in fact, the first public exhibition of gas. Mr. Clegg tells us "The operation was simply effected by fixing a retort in the fireplace of the house below, and then conducting the gas issuing from thence into a copper vase. This was only used on that occasion, the rest of the manufactory being illuminated by the usual small glass oil-lamps, and not with the gas, as has been erroneously stated." As the elder Clegg assisted at this exhibition we suppose he is entitled to speak to the facts.

A year later further improvements took place at the factory; but it was not till 1805 that anything was done to make gas applicable for indoor purposes. In the same year that Dr. Henry was lecturing upon chemistry, and expounding the use of the newly-discovered light, the cotton-mills of Messrs. Phillips & Lee, near Manchester, were lighted up with 1,000 burners. There was, it seems, a bitter rivalry between Murdoch and his pupil Clegg; for the former was experimenting at Phillips & Lee's factory, while the latter was at that of Mr. Lodge. It appears to have been a neck-to-neck race and at last, writes Mr. Clegg, "the cotton-mill of Mr. Henry Lodge, at Sowerby Bridge, near Halifax, was lighted with gas a few nights before that of Messrs. Phillips & Lee," the men working overtime, in order to bring about the first lighting up. With this new evidence of the practical utility of the new light it is not to be wondered at that London refused to remain much longer in the dark.

It would appear that, by a letter dated Paris, November 8, 1801, addressed to the Soho Factory, a Frenchman, M. Le Bon, "had lighted up his house and gardens with the gas obtained from wood and coal, and had it in contemplation to light up the city of Paris." From him one Frederick Albert Winsor, a German, is said to have derived important ideas, and which to a great extent he carried out in the vacant premises of Mr. M'Kenzie, in Green street, Grosvenor square, although, it must be said, Winsor appears to have been deficient in practical mechanical knowledge. However, through many difficulties, he at last succeeded in bringing about very important changes, resulting in his obtaining a patent dated the 18th of May, 1804, in which, describing him as "of Cheapside, London, merchant, he is allowed to exercise and use his invention called 'An improved oven, stove, or apparatus for the purpose of extracting inflammable air, oil, pitch, tar and acids from and reducing into coke and charcoal all kinds of fuel, which is also applicable to to various other useful purposes,'" and by means of which "the inflammable gas or air, being purified from that carbon so pernicious to respiration and dwellings, may be led and conducted in a cold state through tubes of silk, paper, earth, wood, or metal to any distance in houses, rooms, gardens, places, parks, and streets, to produce light and heat." This patent he supplemented by others in 1807, 1809, and 1843, the latter being for special kinds of burners, and describes himself as of Lincoln's-inn-fields, barrister-at-law.

The patent dated Westminster, 7th February, 1809, is of a somewhat remarkable character, for while it fully describes the nature of the invention, there is quite a little history given of the progress made in gaslighting to that date. Mr. Winsor is described as of Pall-mall, Middlesex, esquire, and the patent is for "certain improvements upon my former patent oven, stove, or apparatus for carbonising all sorts of raw fuel and combustibles, and reducing them into superior fuel of coke and charcoal, as well as for extracting and saving during the same process the oil tar, pyroligneous vegetable acid and ammoniacal coal liquors, and for extracting and refining all the inflammable air or gas, so as to deprive it of all disagreeable odor during combustion, and rendering the gas itself salutary for human respiration when properly diluted with atmosperic air, and various methods of applying the above several products to useful purposes." His specification tells us:

"The gas light apparatus consists of two principal parts, the one to carbonise coals, etc., and extract the smoke by heat, and the other part serves to cool, decompose, and refine the smoke. Both vessels must be made air-tight to obtain a perfect analysis of coal or other fuel and combustibles." And he remarks that philosophers have hitherto tried but failed to analyze fuel on a large scale because of the expense and difficulty. "Since my first patent in 1804," continues he, "and my publicly recommending the introduction of coke and gas lights by numerous advertisements, enlarged iron retorts and huge gasometers have been and are now made use of in some manufacturing towns" and, adds he, his present invention is so entirely different to everything yet attempted, that in proof thereof he gives an interesting series of references to all the printed accounts of previous gas light exhibitions. After detailing his invention in full, he continues, "The gas may be used in ornamental, movable, and flexible branches, issuing from the condensing pedestals, such as has been shown in a great variety at the Lyceum in 1804, in Green street in 1805, and in Pall-mall since 1806, to the present time. In Green street, by means of two small stoves placed on each side of the kitchen fire made with coke and one separate condenser, the gas was conducted into the parlor and second floor above it."

[To be Continued.]

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FRIDAY, MAY 16, 1879.

Official Report of Examinations of Gas for two Weeks ending May 10, 1879, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

Apl. 1879.	Time of Day at which Test were made.	New York Gas-Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
28		16.77	17.21	18.77	16.52	16.60	
29	Between	16.72	17.48	18.93	16.72	16.64	
30	9.30 A.M.	16.89	17.59	19.27	16.64	16.66	
May. 1	and	16.67	17.07	18.70	16.52	16.48	
2	1 P. M.	16.73	17.22	18.40	16.21	16.52	
3	"	16.87	17.12	18.48	16.63	16 46	
	Average	16.77	17.28	18.76	16.54	16.56	
5		16.93	17.25	18.83	17.22	16.80	
6		16.62	17.48	19.18	16.83	16.78	
7		16.44	17.5	18.00	16.94	16.91	
8		16.96	17.68	16.15	16.81	16.62	
9		16.99	17.24	18.89	16.86	16.68	
10		16.97	17.20	18.55	16.67	16.88	
	Average	16.82	17.36	18.76	16.89	16.78	

Sugg-Letheby burner.

E. G. LOVE, Gas Examiner

Street Lamps in Boston.—Boston street lamps are to be lighted 15 cents less per thousand for gas used than heretofore. There are also to be 25 per cent less burners used, and altogether the saving will be $37,000. The price for private consumers is reduced from $2.25 per thousand to $2, after the 1st of April.—*Engineering News.*

[*From Our Special Correspondent.*]

Notes from Great Britain.

LONDON, April 30, 1879.

The electric light is being superseded in many instances, and the London Argands, as constructed by Mr. Wm. Sugg, are being brought into constant use. Another gas burner which, at the present time, is occupying considerable attention, is Wigham's, made by Messrs. Edmundson & Co. The increased light given by these different processes is very charming and pleasing to the eye, but the expense at present is falling upon the gas producers, be they company or corporation.

It is not generally supposed that when the public are called upon to pay an increased lighting rate for the additional illumination, that matters will pass so pleasantly, as, at the present time, agitations are constantly gotten up respecting the heavy charges made for street lighting by gas companies.

Until within the last ten years street lamps were paid for at per lamp, burning, say, 4½ or 5 cubic feet per hour for a certain number of hours; but now the average meter system is being very generally adopted, and with much better results for the gas companies, as they now get paid for the gas actually consumed.

In one large London district the local authorities spent something like £10,000 in putting down the meter system, and, after a short trial, found that they should not be able to show a saving. They, therefore resorted to the only means in their power to show the much desired result, *i. e*, the lighting of the lamps considerably after the time prescribed under the old process, and extingnishing them earlier. The district saved but a very trifling sum even under these conditions.

There is still no change in the position of the Durham strike; and it is feared that the men may remain out for some time. This strike will affect our North country gas companies, as they draw their coals principally from the collieries now stopped—London companies have taken a large quantity from them. One of the pits, the property of the Marquis of Londonderry, had last year to deliver 1000 tons of coal per day, for 300 days, to the Gas Light and Coke Company's Works at Beckton.

Gas in London, at the present time, is 3s. 3d. per 1000 feet (less than $1), and yet a gentleman in Kensington Palace Gardens is about to light his house with air gas, in opposition to coal gas—gasoline here at the present time is worth 1s. 10d. per gallon—he is, therefore, not likely to be able to produce a very cheap light.

One of our largest companies, the Gas Light and Coke Company, applied to Parliament this session for powers to manufactnre gas fittings, to inspect, and, where necessary, to condemn existing fittings. They have, however, I understand, decided to abandon the application, so much opposition having been brought to bear by the extensive firms who are manufacturers of gas fittings, etc. It would be exceedingly beneficial to gas companies, and the public at large, if powers were granted that would admit of a thorough examination of all gas fittings before gas was supplied at all. If this principle were adopted, we should not be subject to such frequent fires and explosions, which are not only the cause of very large losses, but, in many cases, lead to the most fatal results.

A Select Committee of the House of Commons, under the Presidency of D. Lyon Playfair, are considering whether it is desirable to authorize public bodies, companies, or others, to adopt the electric light as a means of illumination.

At present the evidence heard has only been of a purely scientific nature, the witnesses, up to the time of writing, being Professors Tyndall and Dr. Siemens. The former gentleman expresses no very clear opinion in the matter of lighting; the latter gives it as his opinion that the electric light will be mainly used for the illumination of large areas; and that one lamp, giving a very high illuminating power, is, in his opinion, the most likely means of producing the electric light. There is no doubt that with the division of the current great loss of power is the result. A very pertinent question was asked Professor Tyndall by the Chairman of the Select Committee:

Q. "Supposing that you have a light produced by one current, say, of 10,000 candles, can you divide that into ten lights, of a thousand candle power each, from the same electric current?"

Ans. "I hardly think so."

With regard to Mr. Edison's inventions, the Professor says—

"I have paid a good deal of attention to that. Mr. Edison is an uncommonly clever man, and, although one sees very serious difficulties in his way, one would hardly be entitled to say that he will not overcome these difficulties; but I do not know that he has, up to the present time, overcome them."

Trade is in a bad state with us, especially in the iron markets. Pipes are fetching a very low price. Pig iron, at Middlesborough, is being sold at from 37s. to 35s. Gas coals are quoted at 7s. per ton on the Tyne.

Gas Light and Coke Company's £100 A stock closed last week at 177-180; and £100 preferred stock at 205–210.

Lighting of Lighthouses.

While the engineer had attained some of his greatest triumphs in the construction of lighthouses, the optician had not once directed his attention to the invention of a brilliant light, worthy to be placed upon the structure which proudly rose high above the waves with the strength and solidity of a rock. During a period of forty years after the completion of the Eddystone tower by Smeaton, the lantern was illuminated by tallow candles stuck in hoops, just as a stand or booth is lighted at a country fair, and so lately as the year 1811 it was lighted with 24 wax candles. In 1812 the Lizzard Light was maintained with coal fires; and in 1816, when the Isle of May Light, in the Frith of Forth, was taken possession of by the Comissioners of the Northern Lighthouses, a coal fire was exhibited in a *chauffer*—a description of light which had been exhibited for 181 years. In 1801 the light at Harwich, in addition to the coal fire, had a flat plate of rough brass on the landward side, to serve as a reflector.

Such methods of lighting were, of course, very deficient in power, and did not enable the mariner to distinguish one light from another—a point which is often of as much importance as the brilliancy of the light itself.

Prior to the invention of the Argand lamp (about 1784) the production of a strong and brilliant light from a single source was scarcely possible, and even such a lamp, by its unassisted powers, would not be of very great value in giving notice to the mariner of his approach to the coast, which ought to be the primary object of a lighthouse. As the rays of a luminous body proceed in all directions in straight lines, it is obvious that in the case of a single lamp the mariner would derive benefit only from that small portion of light which proceeded from the centre of the flame to his eye. The other rays would proceed to other parts of the horizon, or escape upward to the sky, or downward to the earth, and thus be of no value to him. By increasing the number of burners a small portion of light from each burner would slightly increase the effective action, but by far the greater portion of the light produced would escape uselessly above and below the horizon, and also at the back of each flame. Next, the defects were remedied, and the efficiency of the light greatly increased, by placing behind each lamp a reflector of such a form as to collect the rays that would otherwise be lost, and throw them forward to the horizon. The adoption of such a method has led to what is called the catoptric system of lights.—*The Sea: Its Stirring Story of Adventure, Peril, and Heroism.*

Correspondence

[We are not responsible for the opinions expressed by Correspondents. Correspondents, in all cases, should sign their communications with their names and address in full—not for publiction, unless desired, but as a guarantee of good faith.—Ed.]

Purification of Gas by Oxide of Iron.

London, April 23, 1879.

Mr. Editor:—In Mr. Kennedy's interesting communication on the purification and regeneration of fouled lime, inserted in your journal of March 17, he refers to the use of sesqui-oxide of iron for the purification of gas in this country, and to the modes usually adopted for separating the sulphur from the spent material, so as to fit it for further use.

For many years the "spent" has been chiefly used as a substitute for pyrites in the manufacture of sulphuric acid, and as the residue was completely worthless, the value of the spent oxide was only equivalent to that of pyrites. Under a patent process which is now being worked successfully in London, all the valuable constituents contained in "spent" are now utilized in their most valuable form.

An average sample of spent oxide, obtained from any of the London works, will show the following analysis, viz.:

Moisture, 212° F.....	15.1
Crude ammoniacal salts.....	2.6
Sulphur.....	52.7
Prussian blue.....	8.9
Residue.....	20.7

Under the process referred to above, the ammoniacal salts are first removed by washing with warm water, and the liquor resulting is treated in the usual manner for the production of the salt; the residue is then treated with bisulphide of carbon, by which the sulphur is removed almost chemically pure, and finally, after extracting the Prussian blue, the oxide is available as a more active agent than before for the purification of gas—a result never previously attained.

It is well known that oxide of iron will not remove the carbonic acid or the bisulphide of carbon from crude gas, but the use of lime in conjunction with the oxide does away with this difficulty, and affords the nearest approach yet obtained to a perfect system of purification.

In most English works the "spent" formerly contained a very large proportion of ammoniacal salts. Owing, however, to the introduction of improved washing and scrubbing apparatus, very little of the ammonia now finds its way to the purifiers, but is arrested and retained in the place where it is most valuable to the gas companies, viz., the ammoniacal liquor.

The Prussian blue produced by treating "spent" is of a fine deep color, and shows on fracture the bronze hue so much desired by consumers of this article. It finds a ready sale among paper stainers, leather dressers, floor cloth manufacturers, etc., and is, indeed, preferred in many cases to blue produced in the ordinary way.

The great lime difficulty has always been the bugbear of the London gas companies. As most of your readers are aware, the Metropolitan managers are at the mercy of three autocrats, termed referees, in whom are vested powers of the most arbitrary character, in regulating the percentage of sulphur to be permitted in the gas supplied to the public. From their decission there would appear to be no appeal, or, at least, relief is sought in vain, as witnessed by the failure of the Gas Light and Coke Co. to obtain a bill to remove the restrictions on sulphur compounds.

The referees have fixed 15 grains of sulphur other than sulphuretted hydrogen as the maximum quantity to be contained in 100 cubic feet of gas made at Beckton and other suburban works, and 20 grains for that made at works situated in crowded neighborhoods. In winter these maximum quantities are extended to 20 and 25 grains respectively. With lime alone the sulphur can be readily kept down to these conditions, but then at what cost? Great trouble and expense in working, a large increase in capital to erect extensive purifiers, and endless disputes with local authorities on the ground of the nuisance resulting from the fouled lime. If the referees would extend their maximum 5 grains more, say from 25 to 30, all these difficulties would disappear, and oxide of iron alone would be used for purification in the London works, to the complete satisfaction of all concerned in the manufacture of gas.

Reverting to the cost of purification here when oxide is used alone, the gas companies make an absolute profit on the material. As the original fresh oxide takes up at least 50 per cent. of sulphur, besides other constituents, it is obvious that there will be at least two tons of spent material for one of fresh originally supplied. As the price paid for spent material is often considerably over 25 shillings per ton, and the fresh material can be procurred at prices varying from 40s. to 50s. per ton, the advantages of oxide over lime in an economic point of view must be self-evident.

John Wm. O'Neill.

Softening Tar at Outlet of Hydraulic Main.

Office of Works, City Gas Light Co.,
Norfolk, Va., April 23, 1879.

Mr. Editor: About a year ago, wishing to soften the tar at the outlet end of our hydraulic main, I inserted through an open dip a ½ inch steam pipe, allowing the same to rest on the bottom of the main. Soon after turning on the steam, the candle power of the gas then being made increased to an unusual degree, the flame of our jet photometer being similar in appearance to that when enriching our gas heavily with petroleum. I tried the experiment over and over, always with the same result, viz., an increase of the candle power from a half to three candles. I attribute the increased candle power in this case to the fact that the steam vaporized a part of the light oils which are in the tar, and that these vapors were taken up by the gas as it passed. The amount of steam used is equal to what a three-quarter inch globe-valve will let through when one-quarter turn open. Care is to be taken not to overheat the tar, as then it would cause deposits of naphthaline and pitch in the main.

The whole thing is very simple; and, if you think it interesting enough to your readers, you can publish this, and others can then try for themselves, if they wish, and may be benefited thereby.

Yours, truly.
Frederick Eyner.

Gas and Naphtha Lamps in New Haven.

Mr. Editor:—Inclosed please find statement of lamps reported by police for the month of April:

There were 714 naphtha and 117 gas lamps reported, as follows.

Not lighted.....	29	gas,	69	naphtha.
Out of order.....	73	"	644	"
Broken.....	15	"	1	"

We have 900 gas and 411 naphtha lamps lighted every night in the year. Yours truly,

D. C. Sanford.

New Haven, May 10, 1879.

The Water Supply of Paris—Paris is at present receiving over 120,000 cubic metres of pure spring water daily from the river Vanne, but even this large quantity is insufficient to meet the wants of all the inhabitants. A project is in contemplation by the municipality for laying down pipes which would convey a supply to all the inhabitants of the quarters now receiving water from the Seine or the Canal de l'Ourcq. The expense is estimated at £280,000 to £320,000 —*Engineering*.

The Meetings.

The half yearly meetings of the several gas companies have been held, and our readers have had further opportunities of observing what a pleasant state of happiness and comfort gas shareholders are now in. Edison supposed to have collapsed, all is *colour de rose*, and dreams of 12 per cent. in store for these public benefactors are now of nightly occurrence. Amalgamation schemes are rife, and it looks very much as though Mr. Livesey had checkmated the great Magician of the Chartered. We do not like amalgamations, as the enormons compensa ions given to directors and officers, and the increase of monop oply are, in our opinion, adverse to the interests of both shareholders and consumers; but if we are to have amalgamation, we decidedly prefer a North and South confederation rather than one huge corporation which would be more overbearing than the present arrangements, and quite beyond any possible control. We do not quite see how the South Metropolitan can guarantee 11 per cent. to the Surrey Consumers' shareholders, and we very much question if any such arrangement would be allowed by the Board of Trade; and we say this quite as much in the interest of the shareholders as the consumers. Gas directors may rely upon it that if the present mode of paying outrageous salaries is continued, and a rate of interest paid beyond 10 per cent., that the proceedings are merely creating a rod for their own backs with money at two per cent. Consumers of gas in London will sooner or later ride restive under a system which compels them to pay for the continuance of such a high rate of interest. The fact is, the sliding-scale is not being worked fairly in the interest of the consumer, and already we know that more than one Member of Parliament has been consulted upon bringing the subject before the House of Commons, with a view to a Committee of Inquiry as to that and the present auditing arrangements.—*The London Metropolitan*.

Accident at the Paisley Gas Works.

At the monthly meeting of the Gas Trust, on Tuesday night, April 14, the minutes showed that several special meetings had been held in reference to the recent accident at the gas works by the falling of the iron roof of the large purifying shed.

The contractors, Messrs. Hanna, Donald & Wilson, had contended that the accident had occurred through defects in design, and while they regretted very much the unfortunate accident, and had assisted the gas manager in clearing the purifiers of the *debris*, they admitted no obligation to rebuild the roof. They were quite willing, however, to enter into an arrangement to rebuild it if all questions of liability was reserved, and on certain alterations being made in the plans.

The Water Committee had, through Councillor M'Ghee, obtained the services of Messrs. Andrews and M'Culloch, engineers, Kilmarnock, who had inspected the roof, and had reported that the accident was attributable to the giving way of certain cast-iron portions of the roof, many of which were defective. Two architects had also examined the foundations on which the pillars rested, and had reported that any subsidence which had taken place was of a trifling nature. A sub-committee had met with Mr. Wilson, and that gentleman had suggested that the roof should be re-erected at the mutual expense of parties, but that suggestion had not been entertained. The committee had, however, in order to avoid litigation, expressed their willingness to contribute £100 toward the re-erection of the roof. The contractors wished a larger sum to be contributed, and subsequent correspondence had led to the contractors agreeing to re-erect and finish the roof at their own expense, and to throw themselves on the Commissioners' generosity. In reply to Mr. Johnstone, Provost Murray said that the committee had admitted no liability, and had come under no obligation to pay anything.—*Journal of Artificial Light*.

Anthracite Coal in Sonora.

Sonora possesses a vast field of anthracite coal—the only anthracite yet discovered on the Pacific coast. It is said to belong to a very old geological formation probably Silurian or Devonian. The only outcrop which is at present worked lies about 120 miles northeast of Guaymas, and a branch line of the Sonora railway is contemplated to develop it. The mine is a few miles north of the flourishing towns of La Barranca and Los Bronces, each supporting some 2,000 inhabitants. The coal has been used for two years for steam purposes at the Barranca quartz mill The engineer in charge of the mill, who has had a long experience on Atlantic steamers, where he used Pennsylvania anthracite, believes it superior to the latter, the Sonora coal having less ash and leaving no clinkers on the grate. It burns with the short, blue flame of carbonic oxide, which is characteristic of all anthracite coal. There are three veins of the coal, one of which is seven feet thick, another two and one-half feet and the third of unknown thickness, while there are indications of a seam lying beneath the 7-foot vein—the one now worked—of the same or greater thickness. Outcroppings of the vein are traced for many miles. The analysis of this coal as compared with the average grade of Pennsylvania anthracite is as follows:

	Sonora coal.	Pennsylvania coal.
Fixed carbon.....	94–86 p. c.	about 85 p. c.
Ash.....	3–4 "	10 "
Moisture.....	1– 2 "	4–5 "
Sulphur.....	0·0 "	a trace.
Bitumen	0·0 "	a trace.
Spec. grav.....	1·77 "	1·50 "

The dip of the discovery is 26° toward the opening rendering the mine easy of drainage and cheaply worked. The length of the branch from the main line at Noria del Valle (32 miles from Guaymas) necessary to reach the mine is 98 miles. It is estimated that after the construction of the road the coal may be marketed in San Francisco and South American ports at $8 to $9 per ton. San Francisco consumes 600,000 tons of all coals annually, and Mexican, and Central and South American ports consume 650,000 tons, for steamship purposes alone. About 700,000 tons of this is of foreign importation; its value is $6.50 to $10 per ton. The value of anthracite coal is from $12 to $15 per ton. San Francisco consumes about 22,000 tons of anthracite coal annually at present prices. The opening of this mine and its introduction to this market at the prices estimated would be of vast importance to the manufacturing industries of this city and the interior, Specimens of the coal have been brought to San Francisco and exhibited, exciting the admiration of all who have seen it.—*Scientific Press.*

The Suez Canal.

The United States Consul General at Cairo, Egypt, Mr. Farman, has furnished the Department of State with an interesting communication upon the Suez Canal. This is particularly valuable from the fact that Mr. Farman has had access to authentic sources from which to draw his facts.

A few of the more interesting and important items are given. The entire cost of the canal was 472,921,799 francs, or $92,273,907. The stock of the company consists of 400,000 shares, at 500 francs each. These shares have sold as low as 100 francs each. At the opening of the canal they had advanced to only 300 francs. They are now quoted at 717 francs, and are probably worth more.

The British government paid about 568 francs. The number of shares bought in 1875 by Lord Beaconsfield at this price was 176,602. This great purchase, aside from its political and commercial advantages, thus affors a clear profit of 25,000,000 francs at present prices. The balance of the stock is held by a large number of persons, mostly in France.

The revenues of the canal have increased from 5,000,000 francs in 1870 to 30,000,000 francs in 1877. The expenses, including interest, sinking funds, and lands, have been a little over 17,000,000 francs per year. While the revenues steadily increase, the expenses are decreasing or stationary. Deducting the amount paid for interest and the sinking fund, the actual expenses are about 5,000,000 francs annually. The cost of cleaning the canal and its accessories is about 2,000,000 francs per annum. The small comparative cost of maintaining the canal arises from the fact that there are no locks or lateral embankments to be broken. Except the ordinary cleaning, there is little to be done.

Vessels drawing 25 feet of water, or less, pass through the canal. The saving of distance to the British ships going to India is nearly 5,000 miles. Two-thirds of all the vessels passing through the canal carry the English flag. Mons. Ferdinand Lesseps, who has been at the head of the enterprise since its beginning in 1854, expresses the opinion that the Panama Canal must be constructed without locks to be successful or remunerative.—*Iron Age.*

OUR EXCHANGES.

United States.

[*The Plumber and Sanitary Engineer.*]

The Detroit *Free Press* of April 4 says that the use of naphtha lamps there has been unsatisfactory, and quotes Brooklyn as a proof that they *ought* to work. Brooklyn has not tried them yet.

In his examination of the oils to be found in the shops in Colorado, Dr. Ambrook found that nine-tenths of the samples gave off on an ordinary summer day, such quantities of inflammable vapors that a lighted match applied to the mouth of an open lamp would cause an explosion.

The underwriters stated that if naphtha lamps were introduced in Brooklyn the insurance rates would be raised. The incendiaries who have lately caused such a panic in Columbus, Ohio, that the military were called out, have confessed that they obtained from the street lamps the naphtha they used.

On the 29th of April, 1869, the Legislature of Pennsylvania passed an act authorizing gas companies to enter buildings where their pipes ran, for the purpose of repairing them and taking them out. Last month a Mr. Getty, of Pittsburgh, disputed the entrance of the gas company's men, and quite a fight occurred. The end of the matter we have not seen.

Fred. Helbig, a German resident of Zanesville, O., lately suffocated himself with gas. He was missing, and it was found that he had with a chair and the quilt in his possession felt his way to the cellar in the night, there severed the gas pipe, passed one end up his coat sleeve, wrapped himself in the quilt, pressed his face on the shoulder opening of the sleeve, crossed his legs, folded his hands and quietly waited the easy death that ensued.

The experiment of lighting a car by gas has been tried on the Metropolitan "L" road. Compressed illuminating gas is carried in cylinders beneath the car. Each carries a four-hour supply, being charged from a large tank conveniently situated. The gas is conveyed to chandeliers midway between the middle and the ends of the car, the burners being provided with glass shades. Four burners replace six oil lamps with double the illuminating effect, and it is said to be perfectly easy to read by them.

The readers of "Meterites" will remember that the Continental Hotel, Philadelphia, began some weeks ago to make their own gas, and it was stated, with decidedly favorable results, as regards economy. On the morning of April 18th, complaint was entered against them in the Court of Common Pleas on the ground of violation of an ordinance relating to the storage of naphtha. It seems that the citizens in the vicinity of their gasoline tank do not relish such a neighbor. The complainants ask for a perpetual injunction.

Official Inspection of Plumbing Work.

The plumbers of Halifax, Nova Scotia, are greatly exercised anent a proposal to place them and their work under official inspection and control. The immediate cause of this proposed change is not state but it appears that the local legislature has taken t matter in hand with the avowed intention of creatin a licensing board, with power to examine and license plumbers.

A bill for this purpose has been prepared, and its preamble recites that "the water supplied to the citizens of Halifax by the mains and pipes of the city waterworks is largely wasted through imperfect pipes and water-fittings in the houses, and through the carelessness or ignorance of so-called plumbers, through which waste large portions of the city are deprived of an adequate supply, and the danger of the spread of fire is greatly increased."

We in this country have found out all about this sort of thing long ago, and have, as a rule, made local provisions for remedying it. At Leeds, Sheffield, Manchester, Norwich, Yarmouth, and other cities and towns, the question of the waste of water by reason of imperfect fittings has been dealt with in a determined and rigorous manner. Rules and regulations have been made, either by special acts o parliament or under general powers by application to the local magistrates, under the terms of which plumbers are most rigidly controlled, and their work inspected both during its progress and after its completion. In most of the towns just named the waterworks authorities have appointed a certain number of "authorized" plumbers, who are allowed to call themselves by that title on condition that they sign an agreement undertaking to abide by the regulations of the water company or corporation, as the case may be.

The rules and regulations made and provided for the guidance of these plumbers deal with every item of the plumbing fittings of o house or other building. They specify the minimum weight per yard which service-pipes of certain diameters must be, make the use of screw-down bib or stopcock imperative, describe what the material and construction of ball-cocks must be, deal with the inlet and outlet pipes of baths and cisterns, specify the kinds of closets and urinals to be fixed, and generally leave nothing whatever to the discretion of the plumber. As a rule, these regulations matter very little to the plumber, as they chiefly affect the owners or occupiers of the property. It does not, certainly, minimize a plumber's profits if he is compelled to use half-inch lead pipe of 7 pounds to the yard in place of 4 pounds or 5 pounds—indeed, the reverse is rather likely to be the case. All that is required is the same treatment all round, and no favoritism in the matter of inspection. This granted, there would appear to be very little room for the well-conducted and respectable master plumber to grumble.

In the case of the Nova Scotian capital, the proposal seems to have created quite a ferment, and one of the local journals boldly states that the measure cannot be carried out in practice. The Halifax newspaper in question, to our thinking, grasps the wrong end of the stick when it decries the creation of rules such as these as being rendered unnecessary by the ordinary means of detecting waste water, seeing that it is quite clear that the object of the local waterworks authorities is to go to the fountain-head, and, by insisting upon good and sound work when the house is originally erected, to render the risk of subsequent failures of the fitting improbable. The journal to which we allude even declares the suggested control of the internal fittings unlawful, and an improper interference with the "rights of the subject,"—an inference which will not for a moment hold good when tested by the argument that it is for the good of the whole community, and for every member of it, that the fittings of every house should be properly efficient.

We have no desire to pose as the apologists for, or

admirers of, one-half the doings of the monopolist water and gas companies, but common sense properly exercised must inevitably demonstrate that that which is for the benefit of any large number of persons can not in the long run be bad for the members of a special trade, such as the plumbing industry, through the agency of which alone the proposed reform can be effected.—*Ironmonger*,

Iron of Fifty Years Ago.—The Baltimore *Gazette* of April 11 has the following item in regard to some old pieces of iron recently tested in that city. It says: Two specimens of the old iron taken from the Belvidere bridge, recently demolished, were tested by order of City Commissioner Tegmeyer. Specimen No. 1 (wrought iron), length, 11 15-16 inches, was elongated to 12 9-16 inches, and broke only at a strain equal to 52,836 pounds to the square inch. Specimen No. 2, length 10¾ inches, elongated to 12½ inches, broke at a pressure of 61,880 pounds, equal to the best iron made at the present day. Another specimen was reduced one-quarter inch and elongated from 9 to 9½ inches, and broke at a strain of 60,080 pounds. The bolts were placed in the bridge when it was built 60 years ago.

Prices of Gas Coal.

Penn and Westmoreland	$4.50 at New York.
" "	3.50 at Baltimore.
" "	3.75 at Philadelphia.
Despard, Newburgh Orrel, Murphy Run, Fairmont	4.25 at New York. 3.50 at Baltimore.
Chesapeake & Ohio	4.50 at New York.
" "	
Newcastle	3.25 to 3.50
Provincial	3.50 to 3.75
Cannelton Cannel	8.50 at New York.
Ince Hall	7.25

The above prices are about $1 per ton below those of 1878.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)
24 Pine Street, New York City.

May 16, 1879.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share. ☜

Gas Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Central	466,000	50	60	75
Harlem	1,800,000	50	42	47
" Bonds	170,000			103
Manhattan	4,000,000	50	182	187
Metropolitan	2,500,000	100	122	126
" Scrip	$1,000,000	..	99	103
Mutual	5,000,000	100	65	70
" Bonds, gold	900,000	1000	98	103
Municipal	1,500,000	100	110	117
" Bonds	750,000		95	100
New York	4,000,000	100	98	100
Nothern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	133	138ex
Citizens	1,200,000	20	72	80
" Scrip	320,000	1000	90	95
Peoples	1,000,000	10	20	30
" Bonds	325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	60	65
Nassau	1,000,000	25	70	75
" Ctfs.	700,000	1000	90	95
Williamsburgh	1,000,000	50	80	85
" Scrip		...	90	95
Kings Co	200,000	100	—	70
Union Co. E. N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	60	85
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N.Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	95	98
" Ctfs., gold	1,000,000		95	10
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	103
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			128	130
Cincinnati G. & C. Co.				190
Derby of Conn	160,000	100	60	80
East Boston, Mass		25	114	120
Elizabethtown, N. J.	300,000	20	—	130
Fort Wayne, Ind		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	120	125
Hempstead, L. I	25,000	100	...	—
Jersey City	750,000	20	145	155
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	70	80
Lima, Ohio	60,000	100	—	...
Bonds	30,000		90	
Laclede St Louis Mo.	1,200,000	100	—	75
Long Branch		20	30	40
New Haven, Conn		25	136	152
Peoples, Jersey City		...	—	80
" " Bds.				95
Peoples of Albany	650,000	100	—	10
" Bonds	350,000	1000	--	--
Peoples of Baltimore		25	44	48
" Bonds			106	—
Plainfield, N. J	80,000	100	—	105
Perth Amboy		25	—	95
Rochester, N. Y		100	70	80
" Citizens		100	50	60
Toledo, Ohio			95	97
Washington, D. C	1,500,000	20	190	200
" Scrip	500,000	20	100	—
Yonkers		50	70	80
Woonsocket, R. I	150,000	100	80	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
Pittsfield, Mass			120	130
Rondout & Kingston			75	80
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
Troy, Citizens	600,000	100	—	60
San Francisco Gas-Co., S. Fr'isco Cal.			95	95¼

100 shares Jersey City sold at auction at 151.

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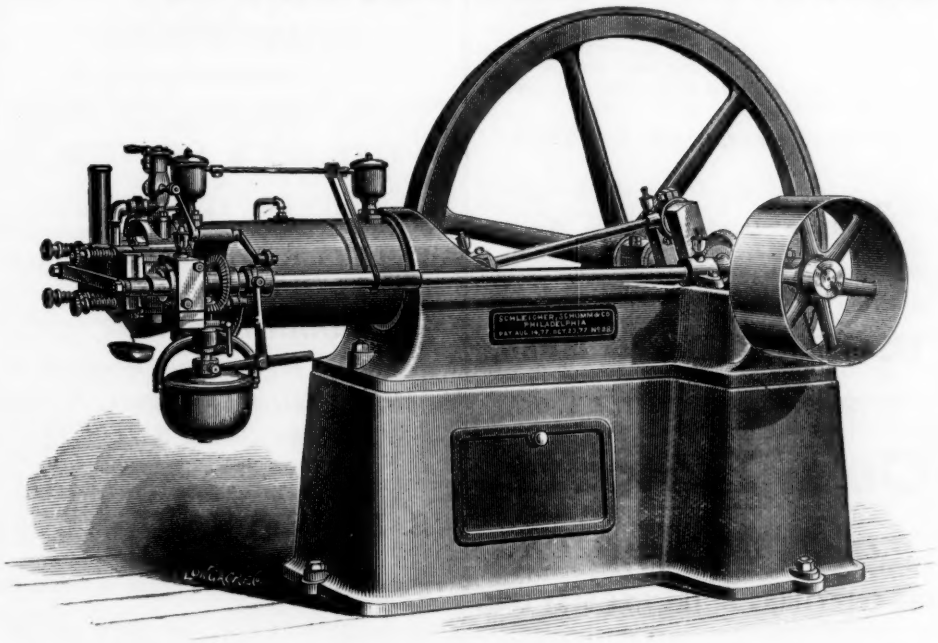

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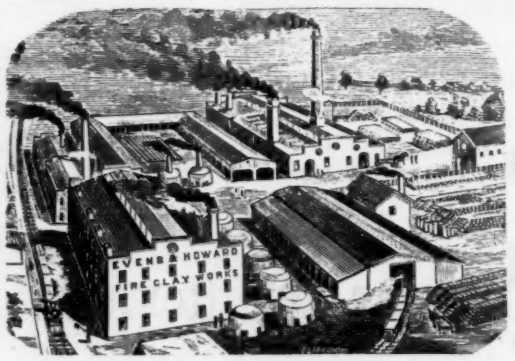

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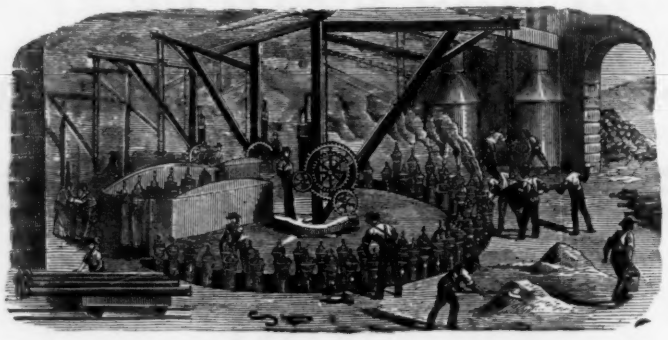

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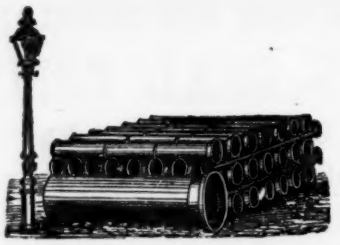

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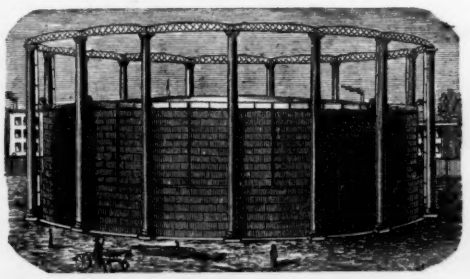

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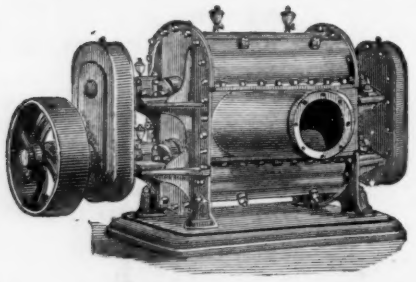

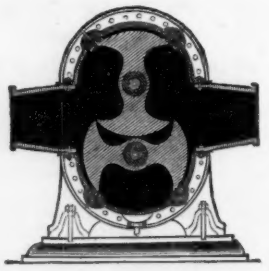

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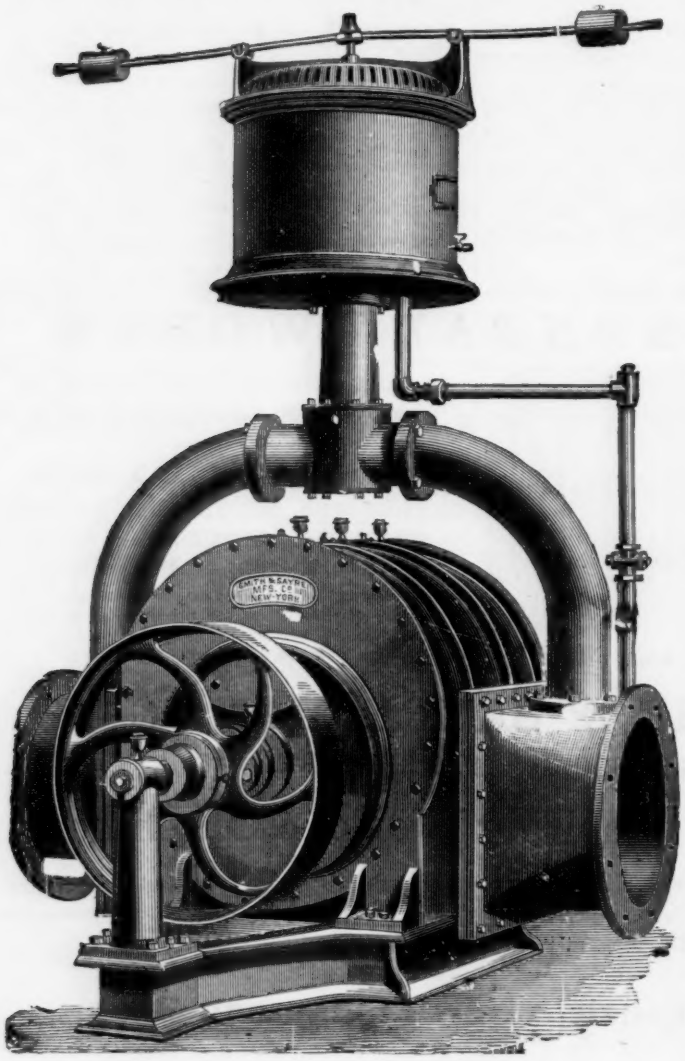

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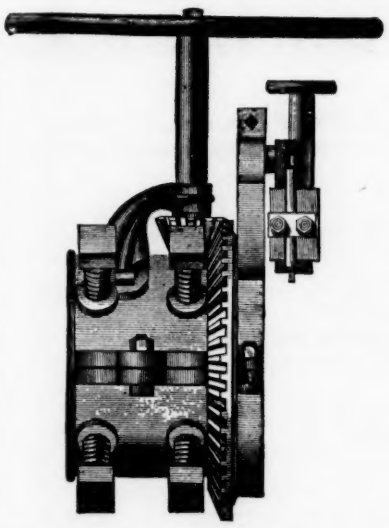

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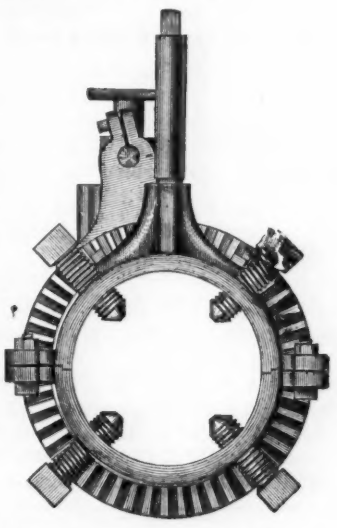

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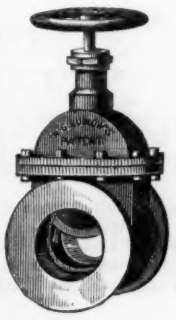

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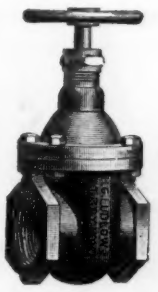

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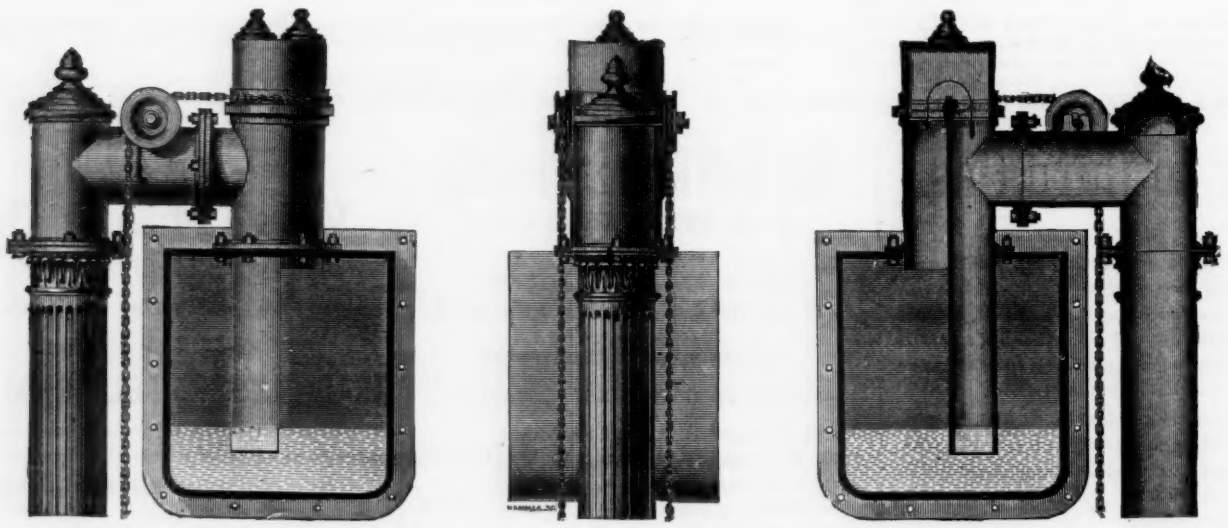

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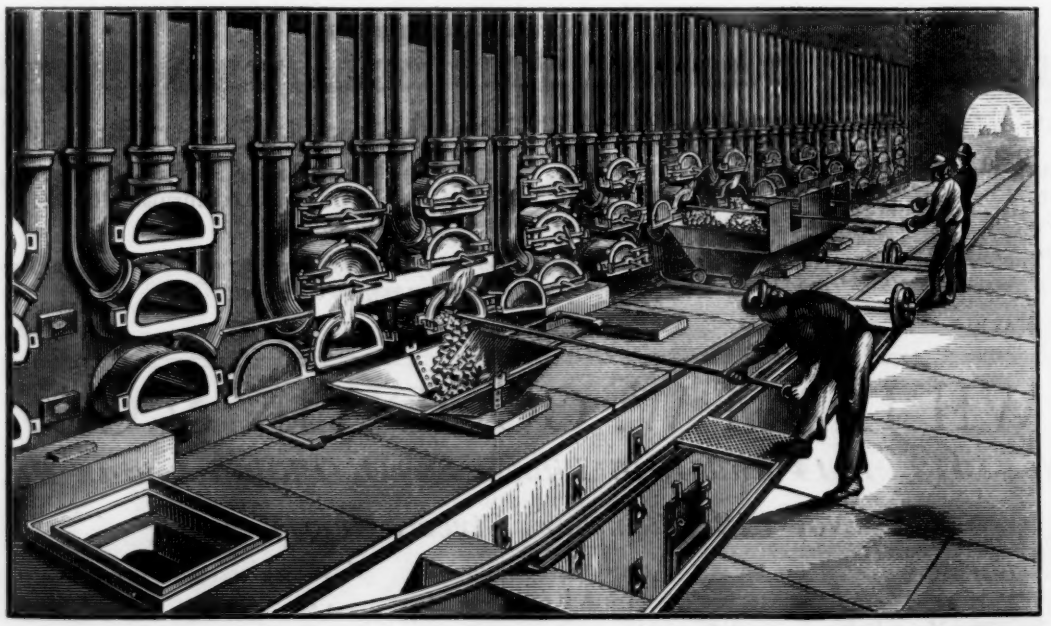

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